URANIA:

OR,

A Compleat VIEW of the HEAVENS;

CONTAINING THE

ANTIENT *and* MODERN

ASTRONOMY,

In Form of a DICTIONARY:

Illustrated with a great Number of Figures,

COMPRISING

All the CONSTELLATIONS, with the STARS laid down according to their exact Situations and Magnitudes, from repeated and accurate OBSERVATIONS.

IN WHICH,

Beside Explanations of all the Terms used in that SCIENCE, by the early as well as late AUTHORS, and in the *Arabian*, as well as the *Egyptian* and *Grecian* ASTRONOMY, the Science is traced from its Origin to the present Period, and the Improvements made, from Time to Time, are laid down in a plain and familiar Manner.

The SUN, STARS, PLANETS, and COMETS are described; and their THEORY explained according to the received Opinions of the present Time; the several Systems of the Universe are delivered; and the CONSTELLATIONS are described at large, with the Number, Magnitude, and Situation of the STARS that compose them; their ORIGIN explained according to the *Egyptian* Hieroglyphics, and the *Grecian* Fable; and a very particular Enquiry is made into the History of those mentioned in the Sacred Writings, and in the Old Poets and Historians.

A WORK intended for general USE, intelligible to all Capacities, and calculated for ENTERTAINMENT as well as INSTRUCTION.

By JOHN HILL, *M.D.*

MEMBER of the ROYAL ACADEMY OF SCIENCES, *Bourdeaux*, &c.

LONDON:

Printed for T. GARDNER, at *Cowley's Head*, in the *Strand*; and Sold by all the Booksellers in *Great Britain* and *Ireland*.

M.DCC.LIV.

TO THE

RIGHT HONOURABLE

THE

EARL of MACCLESFIELD.

My LORD,

HAVING none of the common views of dedicators, and being convinced of the favourable opinion You are pleased to entertain of my application, and perfectly assured of Your LORDSHIP's consummate

A learn-

knowledge in this ſcience, I doubt not but You will pardon my addreſſing the ſucceeding volume to Your Name, without the ceremony of a prior application.

My intent, my LORD, in the work, has been to render the great and important truths, diſcovered by Aſtronomy, familiar to thoſe who have not opportunities to inform themſelves of the calculations, or in the more abſtruſe parts of the ſcience; and to throw together, in a familiar ſtyle, and in one book of moderate price (not without additions, which Your LORDSHIP's experienced eye will readily diſtinguiſh) that knowledge which is diſperſed in many volumes, and obſcured by a multiplicity of terms.

The deſign of this addreſs is to ſhew the world, that I do not fear to ſubject the performance to the niceſt judgment; and that I am convinced that judgment reſts in Your LORDSHIP.

I ſhall

PREFACE.

THE design of the COMPLEAT WORK, of which this volume is the first part, is to convey, to the general body of mankind, *A compleat System of Natural and Philosophical Knowledge*, understanding the latter term in that sense in which it is applied to the objects of the visible creation.

As it is intended for general use, a first care has been to adapt it to all capacities; and this was in no part so essential, as in the present volume. The astronomical knowledge, which does honour to so many treatises, is written for a few, and beyond the reach of ordinary capacities; yet are the truths, and several discoveries, in no science whatever more plain.

These are delivered in the following sheets, and care is taken that they are all delivered there; nor is that the whole: care has been also taken, that nothing but these is delivered; so that he, who is not in a situation to calculate and deduce, has before him the results of the calculations and deductions of others. All that is needful to be known in

Astronomy,

Aſtronomy, for the glory of God, and for the ſervice of mankind; all that is inſtructive, and all that can be entertaining in it, is laid down in the fulleſt manner; and as the book is intended for the uſe of thoſe who are not accuſtomed to calculations, the eye is not offended with the figures.

Had this work been written for aſtronomers, a very different method had been purſued; the form had been that of a ſyſtem, not a dictionary, and entertainment had given place to the abſtruſer ſciences, on which this is founded: but ſuch a work would not at all have ſuited the preſent plan, nor is it neceſſary; all that can be done, in that matter, has been done already; and thoſe readers are able to comprehend it in the form and language in which it ſtands.

Theſe, however, are but few; the perſons for whoſe uſe this is written, are innumerable, the whole body of mankind. The purpoſe has therefore been, to deliver all that is publiſhed in thoſe writings, in a form in which it is fitted for their peruſal; whether it be executed faithfully, others are left to judge.

Nothing is delivered in it that has not been examined, not alone in thoſe books, but in the heavens themſelves, by repeated obſervations. What there is new, is propoſed to the reception of the aſtronomers; if they accept it, the author will have a pride, as well as pleaſure, in having added ſomething to the ſcience. It is his intent, that this volume may ſtand as a ſpecimen of a work he has a great deſire to

render

render uſeful: and it will be his care to compleat the others in no inferior manner.

The whole will be *A compleat Syſtem of Natural and Philoſophical Knowledge*, in ſix volumes, quarto. And in theſe will be contained, a general and particular explication of the SYSTEM of the UNIVERSE; with an hiſtory of the heavens and earth; their inhabitants and contents; or a review of the works of the viſible creation.

Each volume will contain a compleat explication of ſome one ſcience; its terms, ſubjects, and diſcoveries; and will be in itſelf a ſeparate dictionary for that ſtudy. The whole will be delivered in a plain and familiar manner, and diveſted of the obſcurity that attends mere works of ſcience.

The FIRST VOLUME is this.

In the SECOND, will be conſidered the EARTH; its formation and ſtructure; its changes at the univerſal deluge; its ſeveral parts, mountains, ſeas, deſarts, cataracts, lakes, and rivers; together with all meteors, and the phœnomena of earthquakes, vulcanoes, and hot-ſprings; comprehending the whole ſyſtem of coſmogony, and the ſeveral theories of the earth.

In the THIRD, will be compriſed the hiſtory of METALS, MINERALS, and GEMS; of FOSSILS buried in the earth at the deluge, and ſince petrified; of later petrefactions; of ſulphurs, ſalts, and naturally-figur'd ſtones. In this will be comprehended a compleat ſyſtem of metalurgy, mineralogy, and whatſoever other arts relate to the ſtudy of foſſils.

In

In the FOURTH, will be explained the ſeveral ſyſtems of BOTANY; and the vegetables of the different parts of the world, remarkable for their beauty, ſingularity, and uſe, will be treated at large; together with their uſes. In this will be compriſed whatſoever concerns the ſtudy of plants.

The FIFTH VOLUME will have for its ſubjects, the ANIMALS, INSECTS, WORMS, SERPENTS, BIRDS, BEASTS, and FISHES. Theſe will be treated of at large; and the ſeveral ſyſtems of zoology will be explained in this volume, under their proper terms.

The SIXTH will contain accurate and full accounts of the ſeveral MATHEMATICAL, OPTICAL, and other inſtruments, with their different apparatus's, according to the lateſt improvements. In this will be compleat explanations of the ſtructure, nature, and purpoſes of the ſeveral kinds of TELESCOPES, MICROSCOPES, and whatſoever other works of art, are neceſſary for examining the ſubjects treated of in the other volumes.

Each volume will be illuſtrated with a great number of FIGURES, engrav'd after drawings, taken, for the moſt part, from the ſubjects themſelves, in the author's poſſeſſion.

DIC-

A

DICTIONARY

OF

ASTRONOMY.

A.

A, In aftronomy, is frequently ufed to exprefs one of the fixed ftars, but that not always the fame; for there is a ftar of this denomination in every one of the conftellations. It is fo alfo with refpect to the other letters of the Greek and Roman alphabet. When a ftar is mentioned under this defignation, 'tis always with the additional name of the conftellation to which it belongs; and thus to thofe who are acquainted with the figures of the conftellations, and with the catalogue of the fixed ftars, it becomes as determinate a denomination as if the ftar was called by a proper name; and the fame purpofe is anfwered, only in a more familiar manner, and with a lefs load upon the memory, as if a diftinct name had been given to every ftar in the heavens. Thus if an aftronomer, fpeaking of a fixed ftar, calls it the A of Aries, or the B of Orion, it is known that he means that particular ftar in either of thofe conftellations, which is marked by that letter of the alphabet in Bayer's catalogue of the ftars of that conftellation. To know what ftar it is, no more is neceffary than to turn to Bayer, or to any of the aftronomers who have followed him (for they have all adopted the cuftom) and fee where that letter ftands in the catalogue, or againft which ftar in the figure of the conftellation it is placed: this marks the ftar intended by it. Catalogues of the ftars, according to their places in the conftellations, were made very early in the progrefs of aftronomical knowledge, tho' perhaps not till long after the firft conftruction of thofe conftellations. It has been a cuftom to call the oldeft of thefe, that of Hipparchus, and many authors affert this upon the credit of Pliny; but it appears otherwife from Ptolemy's account. When he has occafion to mention the change himfelf had made in the conftellation Virgo, by placing thofe ftars in her fide, which Hip-

parchus had figured in her shoulder, he plainly mentions several successions of astronomers who had departed from the customs of one another in the places they allotted to the stars, which they all allowed to belong to the same constellation. It appears from this, and from many other proofs, that catalogues of the stars, such as they were, were very early. All that is due to the Rhodian, is not that he invented catalogues of the fixed stars, or was the first that made them, but that his were greatly the most correct and full that had at that time appeared. He took into this catalogue the unformed stars, or those not taken into the figure of each constellation, as well as those within its outline; he ascertained the number, and he set down the place of each. Hipparchus lived but 120 years before the birth of Christ. Timarchus and Aristillus, 180 years before Hipparchus, observed appulses of the moon to the fixed stars; and 'tis evident, that there were then figures of the constellations, and the stars that are in them were set down: and the Chaldæan observations mention an appulse of the planet Mars to one of the stars in Scorpio, which therefore they knew where to place, and this 271 years before the Christian æra. Whatsoever others were between, they are lost, and we can only guess at their nature from the mention that is made of them by the other writers. They must however have been very imperfect, and very limited in their use.

The earliest catalogue that has travelled down to us is Ptolemy's, and his we find, partly by what he has said, and partly by the consequences of some of his general acknowledgments, is almost a transcript from that of Hipparchus. After this the Arabians published catalogues, and the astronomers of many other countries followed their example. Tycho Brahe published the first catalogue in which the longitude and latitude of the stars was set down with the necessary accuracy. He did it from his own observations. These catalogues became more and more useful as they were made under opportunities of greater and greater advances towards perfection in the science; but it was not till Bayer that this happy method of distinguishing and characterizing the several stars in each constellation by the letters of the alphabet was introduced. Bayer published his catalogue after Tycho's, and he gave with it the figures of sixty constellations, the old forty-eight of Ptolemy, and twelve discovered afterwards toward the south pole. This was a great extent, and his accuracy in characterizing the stars is very happy; besides fixing their places, he determines their magnitudes as regularly as that which is a mere work of fancy can be done: and that he might be afterwards able to refer, in few words, and with ease and certainty, to any of the stars which he had thus distinguished, he affixed to each a letter, which being considered as belonging to such a constellation, was as a name for the star. What was first intended for his own use became accepted by all the world; and we find all the astronomers, who have written since his catalogue, referring to the stars which they have occasion to name under this kind of designation, and preserving even the letters he has fixed upon. Thus they will mention the γ of Virgo, and the δ of Sagittary, with or without the name of Bayer, as the express names of those particular stars to which he has affixed those letters.

Bayer's catalogue contains no less than one thousand one hundred and sixty stars, and all these are characterised by the letters of the alphabet, beginning with the largest, and so proceeding to the least. Whatsoever be the biggest star in the constellations of which he treats, that is marked by the first letter of the

Greek

Greek alphabet α, the ſtar which is ſecond in ſize in the ſame conſtellation has the letter β, as the ſecond of the Greek alphabet, fixed to it, and the third the letter γ, and ſo on; whence we not only know what are the particular ſtars of the conſtellation, but can even form a rude gueſs as to the ſize of the ſtar from the place of the letter in the alphabet, as the ſtars marked α and β, being the largeſt in the conſtellation mentioned, muſt naturally be ſuppoſed not ſmall ſtars, eſpecially if the conſtellation contains many. Where the number of ſtars in the conſtellation is greater than the number of letters in the Greek alphabet, he has recourſe to the Roman, he takes theſe after the others are all expended, beginning after the Greek omega with the Roman A.

We may know in what eſteem this invention of Bayer's ought to be held, when we obſerve, that all who have publiſhed large or correct figures of the conſtellations ſince the time of their inventor, have continued them. The aſſiſtance of teleſcopes has indeed diſcovered ſtars in ſome of the conſtellations, which increaſe the whole account to a number exceeding that of the two alphabets together, but there can be no occaſion for particularizing them by characters.

AARON. According to Schiller and his followers, one of the new conſtellations of the ſouthern hemiſphere. This author is not content to take out all the figures of the old ones from the heavens, but he has done the ſame with the neweſt. Of theſe indeed he has generally made ſhorter work than with the reſt, taking two or three, ſometimes more, into one of his new-deviſed figures. This of his high-prieſt Aaron contains the ſtars which were before comprehended under the figures of the Crane and Phœnix.

ABIGAL. A name, according to ſome, of one of the northern conſtellations. This is one of thoſe new denominations given by the writers who will allow only ſcripture names to the conſtellations, and ſcripture ſtories to be referred to in them. Abigal is the name by which they have called Andromeda; this is Hartſdorf's innovation, and it is very pardonable in reſpect to Schiller's: that enthuſiaſt has altered the figure, and made it repreſent Chriſt's ſepulchre.

ABILAT. A name by which ſome of thoſe writers, who are fond of uncommon words, have called the moon. It is one of the old Arabic names of that planet.

ABRAHAM AND ISAAC. According to the innovations of thoſe enthuſiaſts, who have ſet up to reform the ſphere, a name of one of the conſtellations. Schiller has been the inventor of this, and the Centaur is the old one that gives place to it. Out of the ſtars forming this conſtellation, he has made two human forms, to which he gives the names of Abraham and Iſaac; but very few have followed him in theſe alterations.

ABRAHAM's RAM. The ſign Aries. Schickard, who is for referring every thing in the heavens to the ſcripture, inſtead of the Pagan hiſtory, will have this conſtellation to repreſent not the famous Ram of the Greeks, but this of the Old Teſtament. *See* ARIES.

ABSALOM's HAIR. A name given by ſome of the enthuſiaſtic writers in aſtronomy to the Coma Berenices, one of the northern conſtellations formed by Conon out of ſome ſtars near the Lion. Theſe writers will not ſuffer any thing to have reference to any except ſcripture-hiſtory, and they will make

this the hair not of Berenice, Ptolemy's queen, but of Absalom, or of Sampson, for so some call it. Schiller will not have it to be that of either, but makes it the scourge with which our Saviour was punished. *See* COMA BERENICES.

ACERRA. A name by which some, who love uncommon words, call the constellation Ara, the altar. This is to be found also among the old poets.

ACUTE *angle*. Is that angle which is formed by two lines nearer to one another, than those are which are placed perpendicular to horizontal; that position forms what is called a *right angle*, and all those which are of less quantity than this are called *acute*. *See* ANGLE.

ADAD. A name by which those, who are fond of uncommon words, sometimes call the sun. It is one of the Syrian names, and it signifies *alone*.

ADAM. A name by which a certain sect of writers have called the planet Saturn. This, like a great many other innovations in astronomy, is to be traced from the enthusiast Schiller. After they had new modelled all the constellations, placed Saint Peter in the room of Aries, converted the Hare at the foot of Orion into Gideon's fleece, and the great Dog into king David; he began with the planets, giving them all scripture names, instead of these Pagan appellations, by which they had been used to be called. Thus Saturn is Adam, Jupiter Moses, and Mars Joshua, the Sun our Saviour, Venus St. John Baptist, Mercury Elias, and the Moon the Virgin Mary.

ADARED. A name by which some, who are fond of unusual words, call the planet Mercury. This is one of its Phœnician names, and signifies a servant or attendant.

ADIR DAGS. A name by which some, who are fond of uncommon words, have called the constellation Cetus. It is the Hebrew name of that constellation, and in that language signifies only a great fish. The giving hands to this fish, for it has two paws that are so called, is supposed to refer it to Dagon, the Syrian idol.

ADON SCHEMEZ. A name by which those, who affect to use uncommon words, sometimes call the Sun. It is one of the Hebrew names, and signifies the lord of heat and light.

ADRA. A name by which some fanciful writers on the heavens, have called the sign Virgo. It is the Arabic name of the constellation; they call it also Adrenedepha.

ADRENEDEPHA. A name by which some fanciful people have called the constellation Virgo. 'Tis the Arabic name: but it is very idle to use it where the other is established.

ÆGIPAN. A name by which some of the old astronomers have called Capricorn, one of the twelve signs of the zodiac. They suppose that Pan, in terror of the giant Typhon, converted himself into this animal, half goat and half fish, and so escaped destruction.

ÆGOCEROS. A name by which some fantastical writers have called the constellation Capri-

Capricorn. 'Tis one of the old Greek names of that ſign.

AËTUSE. A name by which ſome have called the conſtellation Eridanus. It is one of its old Greek names, and occurs in Lycophron, and ſome other writers.

AGALA. A name which ſome of the writers in aſtronomy have called the Urſa Major, or great bear. It is an Arabic name of this conſtellation.

AGANNA. A name by which ſome of the aſtronomical writers have called the Urſa Major, or great bear. It is an Arabic name of that conſtellation. At leaſt Agalais, the Arabic name, is a tranſlation of the Greek Amaxa, a waggon, for that was the name by which this was firſt called, and Aganna is only a corrupt way of writing the word Agala, as they write Fohm-al-Haut, Fomahaut.

AGLINAM, or *Al Aglenam*. A name by which ſome have called the cluſter of ſtars in the hands of the conſtellation Cepheus. 'Tis an Arabic name for thoſe ſtars, and ſignifies ſheep. They call the ſtar in the foot Rai the ſhepherd, and that between the feet Kell the day.

AHAD. A name by which ſome, who are fond of uncommon words, call the Sun. It is one of the Syrian names, and properly expreſſes *alone*.

AIGAR AL ASAD. A name by which ſome, who are fond of uncommon terms, have called the conſtellation Corvus. It is one of the Arabic names, and ſignifies Clunes Leonis.

AIN AL THAUR. A name given by ſome to the great ſtar in the bull's eye, called alſo Aldebaran. Ain al Thaur is its Arabian name, and the words expreſs *the eye of the bull*. The name Aldebaran is alſo Arabic, and ſignifies the ſtar of ſuperiority.

AKALE, or *al Akale*. One of the names by which the aſtronomical writers call the conſtellation Aquila. The word properly ſignifies a tormentor.

AKATRAB. A name by which ſome have called the conſtellation Libra: 'Tis its Hebrew name.

AKRAB, or AKALKRAB. A name by which ſome of the early writers have called the conſtellation Scorpio. It is the Hebrew name of this ſign at large or abbreviated.

AKBER, or DUB AKBER. Names by which ſome of the writers of aſtronomy call the Urſa Major, or great bear. It is the Arabian name of that conſtellation.

ALAREVO. A name by which ſome, who are fond of uncommon words, have called the conſtellation Scorpio, one of the twelve ſigns of the zodiac. It is the Syriac name of that ſign.

ALASHA. A term by which ſome have expreſſed the ſtars in the tail of Scorpio It is only a miſ-ſpelling of the term Alſhaula, the Arabic name of this part of that conſtellation; it is alſo called Shamelau on the ſame foundation.

ALBEZ. A name by which ſome, who love uncommon words, have called the Centaur. It is one of the Arabic names of that conſtellation. They call it alſo Aſmeat.

ALECTOR, *the Cock*. A name of a conſtellation formed by ſome perſons out of certain ſtars belonging to the Ship, but it has not been allowed generally. The ſtars are very well deſcribed in the Ship, and are referred to it by moſt.

ALEXANDRIA, *Climate of*. The climate of Alexandria was the third of the Arabic climates north of the Equator. Before the method of ſetting down the latitudes of places, in degrees and minutes, was found out, the cuſtom was to do it by a diviſion of the ſurface of the globe into climates, and ſo ſpeak of the place referred to as ſtanding in the beginning, in the middle, or in the end of ſuch a climate. They divided ſo much of the earth, as was known to them, into ſeveral climates, the firſt beginning at that parallel where the length of the longeſt day was twelve hours and three quarters. Each climate reached to the parallel at which the longeſt day differed in length half an hour, from that part of the parallel at which it began; and it was their cuſtom to name theſe climates from ſome conſiderable place that was at or near the middle. The parallel that paſſed at equal diſtance in point of time (for it was not the ſame with regard to ſpace) that is the parallel at which the longeſt day was a quarter of an hour longer than that at one parallel of the extremity, and a quarter ſhorter than that at the other in this climate, was ſuppoſed to paſs through the city of Alexandria in Ægypt; therefore this city, a ſufficiently remarkable place, was ſuppoſed to be in the middle of the third climate, and that climate was thence called the climate of Alexandria.

ALGABBAR. A name we find in ſome of the old aſtronomical writings applied to a conſtellation, but thoſe who have attempted to explain the authors, do not ſay to which of three, Ophincus, Hercules, or Orion. The word expreſſes *giant*, and theſe are all gigantic figures in the heavens, but it certainly belongs to Orion; for whatſoever may have been the original name of the others, 'tis known of a certainty, that Orion was originally called Chimah, and that Chimah ſignifies a giant, and a man in armour.

ALKAMER. A name by which ſome, who affect to uſe uncommon words, call the moon. It is one of the names by which the Arabs called that planet.

ALKAS, or *Alkis*. A name by which ſome, who are fond of uncommon words, call the conſtellation Crater; it is one of its old Arabic names. The word ſignifies a cup.

ALKALE. A name by which ſome, who are fond of hard words, call the conſtellation Aquila the Eagle; it is one of the Arabic names of that conſtellation, and ſignifies torment.

ALIQUANT *part*. A part of any number or quantity, which, being ever ſo many or ſo few times repeated, will not produce the whole number or quantity: ſuch as will are called aliquot parts. *See* ALIQUOT.

ALIQUOT *part*. A part of any number, or of any quantity, which, being repeated a certain number of times, will produce the whole quantity. Thus, in numbers, three is an aliquot part of twelve, becauſe being four times repeated it produces twelve; and, in meaſure, a line of a foot long is an aliquot part of

of a yard, becauſe three times repeated it makes the whole yard. On the contrary, five being ever ſo many, or ever ſo few times repeated, will not make twelve, and therefore five is not an aliquot part of twelve, but an aliquant part.

ALITTA. A name by which ſome, who are fond of uncommon words, call the moon; it is one of the old Arabic names of that planet.

ALKETUS. A name by which ſome, who are fond of uncommon words, have called the conſtellation Cetus; it is one of its Arabic names, and is doubtleſs formed from the Greek name Cetus. The Greeks alſo called it Preſtis and Orphys; and the Latins, Leo Marinus.

ALMANTAR. A name by which the aſtrological writers, when they have a mind to be more than ordinarily obſcure, have called what they generally expreſs by the term Aſpect, that is, as they will explain it, a mutual radiation of certain planets and conſtellations on one another at certain diſtances, or under the favour of a conjunction. In theſe Almantars, or Aſpects, they pretend that the ſtars and planets co-operate together, and from theſe they preſage events, and make all their pretenſions to knowledge of futurity. The ſeveral Almantars, or Aſpects, beſide thoſe of conjunction and oppoſition, are, the Sextile, the Quadrate, and the Trine or Trigon. In the firſt of theſe the ſtars and planets are at ſixty degrees diſtance, in the ſecond at ninety, and in the third at one hundred and twenty. Theſe, with the other two, when they are together, or when they are half a circle, or one hundred and eighty degrees diſtant, make the five Aſpects of the aſtrologers; and this hard word Almantar is only the Arabic term for Aſpect.

ALMEGIREL. A name by which we find ſome of the aſtronomical writers, who love hard words and uncommon terms, calling the Via Lactea, or milky way. It is one of the obſolete names that have been uſed by the Arabian writers.

ALMEGRAMETH. A name by which ſome, who love hard words, have called the conſtellation Ara the altar. It is one of the Arabic names of that ſign.

ALMICANTARAHS. A term uſed by aſtronomers to expreſs certain circles, which are continued parallel with the horizon. The two kinds of circles dependant on the horizon, are the ſecondaries or verticals and the parallels. The firſt of theſe are what are called Azimuths, and the latter Almicantarahs, for aſtronomers are too fond of hard words; but it would be much more intelligible, and much more expreſſive, to call them by the proper names of the verticals and parallels. The number of theſe circles of both kinds, may be as great as we pleaſe, for they are, like the other circles of the ſphere, imaginary; and we may conceive them as diſtant from, or as cloſe to, one another, as we pleaſe. All the Azimuths, or Verticals to the horizon, be there ever ſo many of them, are equal to one another in ſize; for they all paſs thro' the ſame two points, the Zenith and the Nadir, or the poles of the horizon; but it is otherwiſe with reſpect to the Almicantarahs, or parallels, for as they are all of them in different places between the broad circle of the horizon, and the point of the Zenith, they muſt be the largeſt as they are neareſt to the horizon, and ſmaller as they approach to that point. Thus the higher any parallel or Almicantarahs is in the heavens, the ſmaller it alſo is, and the lower and larger; whereas the

Verticals,

Verticals, or Azimuths, have no difference except the place.

To theſe two kinds of circles are to be added a third, called from their uſe circles of ſtance, and then we have all the circles which aſtronomers ſpeak of, as having relation to the horizon. As the Azimuths are vertical to the horizon, and the Almicantarahs parallel, the circles of diſtance are oblique. The uſe of them is to meaſure the diſtance of any two points in the heavens. To this purpoſe a circle is always neceſſary, as all meaſures in the ſphere of the heavens are taken by the degrees of a circle. If therefore it be required to meaſure the apparent diſtance between two ſtars in two different points of the heavens, we are firſt to conceive a great circle to be ſo drawn as to paſs thro' both of them. This is what is underſtood by the term circle of diſtance, and this being, like the Azimuths and Almicantarahs, imaginary, may like them be conceived in any part of the heavens where it is neceſſary for meaſuring, and when it is conceived, all that is to be done to denote the ſpace or diſtance between the two ſtars, is to find how many degrees of this circle are intercepted between the two points, or what is the meaſure of the arc of that circle ſo intercepted. There are alſo other uſes of theſe circles of diſtance, which muſt be explained hereafter under that head. This is ſufficient to know what they are with reſpect to the Verticals and Parallels.

ALMICANTARS. Thoſe circles which are parallel to the horizon, and which terminate the height of ſtars. *See* ALMICANTARAHS.

ALMUTABEL ALGANULI. A name by which thoſe, who love ſtrange names for every thing, have called the ſouthern triangle; 'tis an Arabic name of their forming for a conſtellation the Arabs know nothing of.

ALNETARA. A name by which ſome of the old aſtronomers have called the large ſtar in the conſtellation Cancer, commonly called Præſepe. *See* CANCER.

ALOHOR. A name by which ſome, who are fond of uſing uncommon words, have called the conſtellation Lyra; and alſo the great ſtar in that conſtellation, which is called Lucida Lyra, and ſometimes in the Latin ſingly Lyra, by the name of the whole conſtellation. The word Alohore is a ſtrange and barbarous one. The Arabs called the conſtellation Al Lura from the Greek name, and as it has always been cuſtomary to call this bright ſtar by the name of the whole conſtellation, ſome of the writers, who did not well know what they were about, wrote down its name Alhandor, by ear, and others giving it that of the conſtellation to which it belonged, called it Al Lura, or, as they wrote the word, Allore, or Alohore.

ALPHAROS. A name by which ſome, who are fond of uncommon words, call the conſtellation Pegaſus; it is made out of the Arabian name of the ſign, which is Alpharas; but the Arabs always add an epithet of diſtinction, that it may not be confounded with the Equuleus, or Little Horſe. They call the Pegaſus, Alpharas Adam, which ſignifies the greater horſe, or Alpharas Al Thani, which ſignifies the ſecond horſe.

ALPHRÆGANUS. A name by which ſome, who are fond of obſcure words, have called the conſtellation Serpentary. They call it an Arabic name of that conſtellation, but it is not properly ſuch; the true name by which

which it is called in that language, Al Hauwa and Al Haugue. This ſtrange word may poſſibly be a falſe ſpelling of the latter of theſe terms.

ALPHUN. A name by which ſome, who love uncommon words, have called the conſtellation Crater. Kircher ſays 'tis one of its Arabic names, but it would be hard to find in which of their authors he met with it. The people who uſe the word have it from him.

ALSERTAN. A name by which ſome of the aſtronomical writers, and by which a great many of the aſtrological ones call Cancer; 'tis the Arabic name of that ſign.

ALSHAMARICK. A name by which the people, who love hard words, have called the Centaur and the Wolf, making together one of the ſouthern conſtellations. The word is Arabic, and it was uſed by ſome of the authors of that nation to expreſs theſe very ſtars. They had other names for the conſtellation, for they called it Albore and Aſmeat; but we find them ſometimes ſpeaking of all the ſtars that compoſe both the Centaur and his prey, by this long and hard word; 'tis an adjective in that language, and ſignifies dappled, or variegated, and probably was meant to expreſs the diſpoſition of the ſtars.

ALSUGIA, or ALSHUGIA. A name by which ſome, who are fond of uncommon words, have called the conſtellation Draco; it is one of its Arabic names, and ſignifies a ſlender ſerpent.

ALTARE. A name by which ſome of the old Latin writers call the conſtellation Ara.

ALUK. A name given by thoſe, who are fond of hard words, to the conſtellation Aquila; it is a Perſian name for that conſtellation, and ſignifies a black eagle.

AMALTHÆAN GOAT. A large ſtar near the ſhoulder of Auriga, called Capra by the Latin writers. It is by ſome called Sus the Sow, that animal, and not a goat, being ſaid by Agathocles and ſome others, to have ſuckled Jupiter, and ſo to have got up into the ſkies.

AMAXAS. A name by which ſome of the aſtronomical writers have called the Leſſer Bear, and ſome the greater. The antients ſometimes ſuppoſed the ſtars of theſe two conſtellations formed into two waggons drawn by oxen. *See the articles* URSA MAJOR *and* MINOR.

AMMON, or JUPITER AMMON. A name which ſome of the old writers call the ſign Aries.

AMORPHOTÆ. A term by which the old aſtronomers expreſs thoſe ſtars, which at preſent we call Stellæ Informes, and in Engliſh unformed ſtars. It denotes thoſe which are ſituated between the ſeveral conſtellations, and not compriſed within the outlines of any of them; theſe are ſpoken of by aſtronomers under the name of the Stellæ Informes, or Amorphotæ of this or that conſtellation; but the number of them has, from time to time, much decreaſed. The uſe of the conſtellations is plainly that men might be able to ſpeak with more certainty and preciſion of the fixed ſtars, than they could do otherwiſe, and conſequently all the unformed ſtars, wanting the advantage of ſuch a diſpoſition and arrangement, the ſcience was ſo far defective. Aſtronomers have been ſenſible of this, and they have, by degrees, remedied the imperfection more and more. The received conſtel-

conſtellations, were originally only forty-eight, they are now ſeventy. Antinous was added, formed out of the ſtars below the eagle, which had been uſed to be called unformed ſtars of that conſtellation; and the Coma Berenices, or queen Berenices's hair, out of thoſe behind the tail of the lion, which had been uſed at other times to be ſpoken of under the name of Stellæ Informes of Leo. And in the ſame manner Hevelius has added the Lynx, the little Lyon, the Greyhounds, Cerberus, the Fox and Gooſe, Sobieſki's ſhield, the Lizard, the Camelopardal, the Unicorn, the Sextant, all out of the unformed ſtars, of one or other of the northern conſtellations; and the voyagers who have croſſed the line, and aſtronomers who have gone to the proper places on purpoſe, have added to the ſouthern hemiſphere, thoſe of the Dove, the Royal Oak, the Phœnix, the Indian, the Peacock, the Bird of Paradiſe, the Bee, the Camelion, the Triangle, the Southern Fiſh, the Sword Fiſh, the Flying Fiſh, the Toucan, and the Hydra. by the addition of theſe, at theſe different periods, many of the vacant ſpaces in the heavens are filled up, and many of the before unformed ſtars brought into conſtellations, under the figure of which we are able to ſpeak of them with preciſion; but yet there are a great many ſtars left unformed, and ſome ſpaces in the heavens, occupied by ſuch of them as are very conſiderable, are left without inhabitants.

AMPLITUDE *Riſing*, or *Ortive*. The arc of the horizon, contained between the eaſt point, and the place where a ſtar riſes, is called the Ortive Amplitude of that ſtar. *See* CIRCLES *of the ſphere*.

AMPLITUDE *Setting*. The arc of the horizon, contained between the weſt point, and the place where a ſtar ſets, is called the ſetting amplitude of that ſtar. *See* CIRCLES *of the ſphere*.

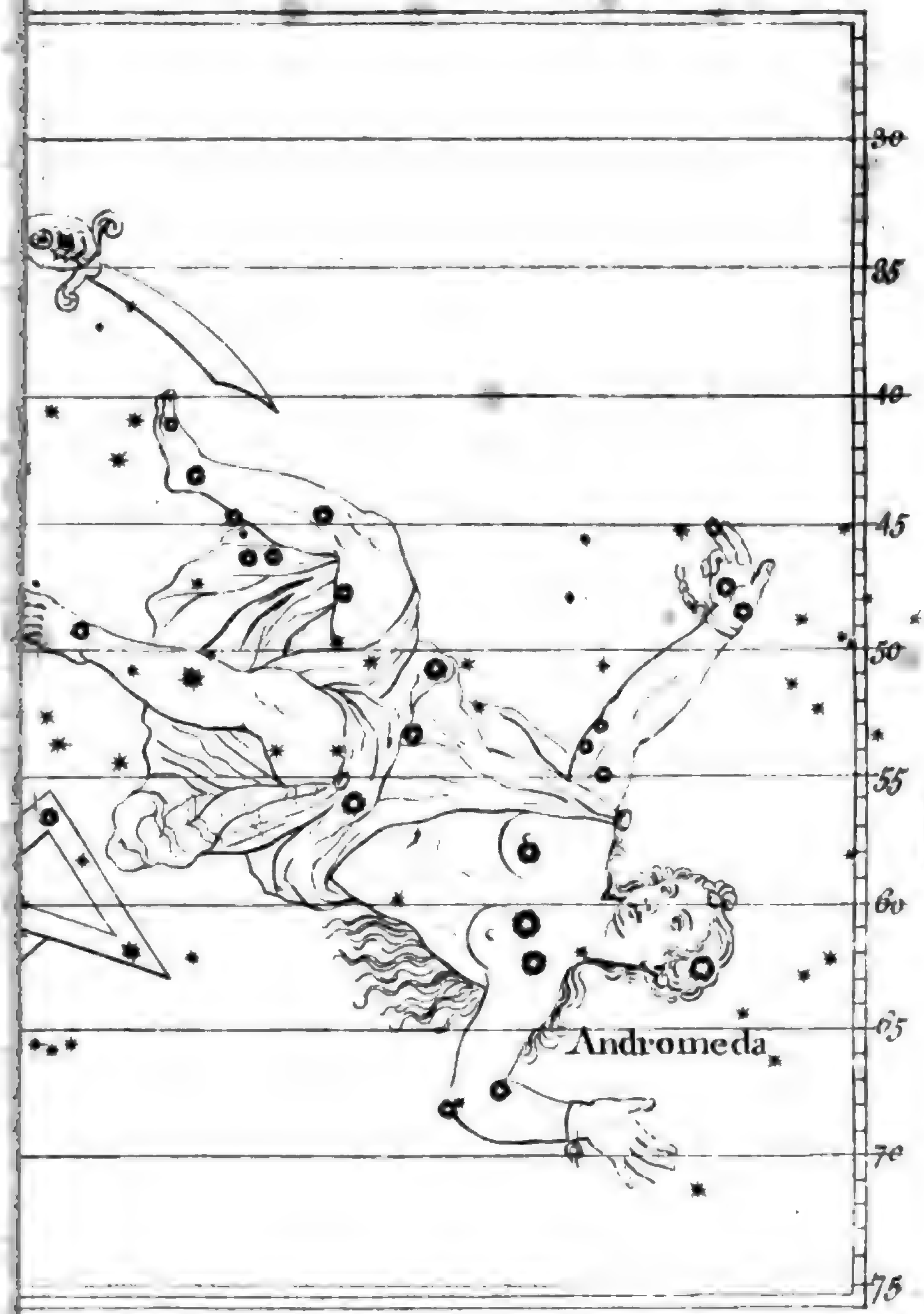
ANAITES. A name by which ſome, who are fond of uncommon words, have called the moon. It is one of the Perſian names of that planet.

ANCILLA. A name given by ſome fantaſtical people to the laſt ſtar in the tail of the Great Bear; the term at large is Ancilla Marthæ. Theſe writers make the Bear to be the Bier of Lazarus, and the three ſtars in the tail Mourners; Mary, Martha, and her maid.

ANDREW, or *Saint Andrew*. A name given by Schiller and his followers, to be the ſecond ſign of the zodiac; he has placed the figure of St. Andrew in the place of the Bull, and arranged the ſtars, though very aukwardly, under it. *See* TAURUS.

ANDROMEDA. One of the conſtellations of the northern hemiſphere, and a very conſiderable one. It is mentioned by all the writers in aſtronomy of whatever period from the earlieſt among the Greeks, and is one of the forty-eight original aſteriſms or figures under which they divided the ſtars. Theſe all ſeem to have been brought into Greece together with the ſigns of the zodiac at, or about the time of Thales, and to have been of the Ægyptian origin. The figures into which they are diſpoſed ſavour much of the hieroglyphical writing of that nation, and we are not to be miſled by the Greek names and Greek fables which are annexed to them; and to which they ſeem to have received their origin. Theſe have been added very long afterwards. Andromeda is a conſtellation of conſiderable extent, and though it has not ſo many ſtars comprifed

1



Andromeda

comprifed within the figure as fome others which occupy a fmaller fpace, yet is not without thofe which are fufficiently confpicuous, and they are fo difpofed as very happily to mark the figure. Andromeda is reprefented in the heavens in form of a woman, not much better than naked, with her arms extended, her feet at a diftance from one another, and the fragment of a chain about each wrift. She has nothing upon her head, and, except for a loofe robe thrown over a part of her body, is quite uncovered; but her hair is reprefented as covering her temples, and there containing a confiderable ftar, and as flowing down to her waift behind her.

The conftellations near to Andromeda are Caffiopeia, Perfeus, and the Triangle; the Horfe, and Aries and Taurus are at a diftance. She is placed over the head of Perfeus, but her right foot comes very near his fword. Caffiopeia's palm-branch comes very near her right knee, the Horfe is at her head, Aries and Taurus are at a diftance on the left, and the Triangle comes very near to a part of her robe on the left fide.

The antients counted feventy-three ftars in the conftellation Andromeda, and thofe who are not accuftomed to aftronomical enquiries of the nicer kind, will always form the beft idea of what they are to expect in the heavens, by following their account. Ptolemy gives that number to it, and he is a profeffed and facred follower of Hipparchus, who, as fome fay, made the firft catalogue of the fixed ftars that ever appeared in the world; an attempt that ftaggered the capacities of his cotemporaries, and was looked upon by Pliny, that is, by fome early writers of credit, whom Pliny copied, to be the work not of a man, but of a god. Tycho continues the number of ftars at twenty-three to this conftellation, but Hevelius diftinguifhes forty-feven in it, and Flamftead no lefs than fixty-fix.

There are many of them of the larger fizes, and they are difpofed very happily over the figures. There is a very bright and confiderable one in the hair on the left temple, three on her breaft. Three in her right hand, and feveral on each arm. There is another confpicuous one at her waift, and two others in a line with it. Thefe are on the robe, or, as fome exprefs it, on the girdle of Andromeda, but that is a part of the drefs not given in the oldeft figures. There is alfo a confiderable one upon her left foot, and two upon the right; and feveral on each leg.

What the Egyptians meant by the figure of a woman with her arms extended, (for that feems to be all the figure they gave to the afterifm) is not eafy to fay. As to the chains, they are doubtlefs of Greek origin; they contain no ftars that are of any ufe to the figure as a conftellation, whatever they may be to the fable. Thefe people, eager to have the fcience believed of their origin, and endeavouring to adapt fome part of their own ftories to every conftellation, added thefe fragments of chains to the two wrifts of the figure; and then having already placed the valiant Perfeus among the ftars, or adapted the name of Perfeus to an Egyptian figure, and put a fword into its hand, as they have chains upon the arms of this, neither of them containing any ftars of note; they made this woman the Andromeda delivered by the hero: and afterwards, to commemorate all the family, they gave the names of Cepheus and Caffiopeia, father and mother to the diftreffed virgin, to two other of the forms into which they found the conftellations ranged among the Egyptians. They tell you, that for an offence of her mother's, this virgin was tied to a rock to be devoured by a fea monfter. When Perfeus came into the country, he refcued the damfel, and married her; fhe preferring to her friends and country the following the

fortune of that hero. Minerva, they say, at her death, removed her into the heavens, and placed her near to her victorious husband.

Whatever regard is paid to the history, the figure of Andromeda is preserved by the astronomers of all nations and all times, except by the Arabians. The religion of these people did not suffer them on any occasion whatsoever to draw the figure of an human body, so that they have been forced to place something else in the stead of all those, which, in other authors, have this character. Thus Aquarius, with them, is represented by a mule saddled with two tubs of water on his back, and Auriga by the same animal unloaded. For Gemini they give a pair of peacocks, for Virgo a wheat-sheaf, for Ophincus a crane, for Hercules a camel, and for Cepheus and Cassiopeia a dog and bitch; but they preserve the chair of the latter; for Sagittary they give only a quiver of arrows, and poor Andromeda is degraded into a sea calf.

Among the enthusiasts, who have given new names, and even new figures, to the constellations, this has not escaped. Schickard has banished the name Andromeda, and put the scripture-name Abigail in its place; but Schiller has demolished the whole constellation; he has given the figure of a sepulchre in it its stead, and called it the Holy Sepulchre.

ANGLE. Astronomy adopts this term from the mathematics. It expresses the opening which is between two lines which touch one another in a point. An angle is always formed by two lines thus put to one another, unless they are joined absolutely end-ways. When we speak thus of an angle, we consider the relation between the two lines, as they go from one another, and from the point at which they touch. To prevent confusion, it may be proper to add, that those who consider the same relation in the contrary progress, or speak of it as it concerns the lines in their way from their greatest opening to the point, call it the inclination of two lines toward each other, which meet in a point.

This is the general definition of an angle; but as it may be formed of lines of different figure and denomination, it becomes in itself different, and acquires a new name, under each appearance. The three great distinctions are expressed by the terms *rectilinear*, or right-lined angle, *curvilinear*, a crooked-lined angle, and *mixt* angle, or that formed of both kinds.

When the lines which form the angle are both strait, it is called a *rectilinear angle*.

When the lines which form the angle are both curves, then arises the *curvilinear angle*. And when one of the two lines is strait, and the other crooked, there appears the *mixed angle*. To speak with the precision which is necessary in these studies, astronomers have applied names to the several parts of the lines which form the angle: the two lines are called its *legs*, and the point in which they touch is termed the *vertex* of the angle by some, and by others the angular point. For farther accuracy and ease in the description, they also have a custom of marking the three points of the angle, with three letters of the alphabet; one of these they affix to the end of each of the lines, remote from that point in which they touch; and the third letter to that point, or the vertex of the angle. Sometimes when there is less fear of confusion, or perplexity, they mark the whole angle, by way of distinction, only with one letter. When they use three letters or figures, it is always the custom in describing the angle, to mention that of the three, which is placed at the vertex in the second place.

In describing the extent of an angle, regard is not had to the length of the lines

which

which form it, but to their distance towards the extremities; for the *quantity* of an angle does not depend upon the extent of the legs in length, but upon the width of their opening. A common doubled ruler, or a pair of compasses which move upon a hinge or joint, at the vertex or point where they join, when the legs are separated from one another at the points, form an angle. In this case the two portions unite at one end as the two legs of an angle, and the place where they are fixed together, by the joint or hinge, is the vertex. With the same pair of compasses it is possible to form a great variety of angles, all of different quantity from one another, by opening them in different degrees. It is no matter that the legs continue the same length howsoever they are moved; the angle that is formed by the opening of them differs in proportion to that opening, and its quantity is greater as they are placed farther asunder, and lesser as they are brought nearer together.

It is possible so to place two lines, or two strait pieces of wood, so that there may be formed not one, but two angles by them; but to this end they must not be jointed together. If one strait line be drawn horizontally upon paper, and another be drawn perpendicularly from a higher part, till it touch the first with its lower extremity; that is to say, if the second, or vertical line, do stand exactly upright upon the first or horizontal line, then there will be formed by these lines two angles, one on each side of the perpendicular line, and these will be as equal as possible, because the second line is supposed to stand perfectly upright upon the first, and not to lean one way any more than another. These are called *Right Angles*. If, instead of drawing down the perpendicular line to the middle, or to some intermediate part of the horizontal line, it had been drawn down to touch it in a point at the end, this also would form what is called a *Right Angle*, but then there is only one. To return to the familiar instance of the compasses, it is possible to raise one leg of these till it be perpendicular to the other, and then there is formed a *Right Angle* by the instrument: This may be esteemed as a sort of medium between two other species of angles of different denominations; for if the legs of the compasses be, from this situation, pressed nearer to one another, they form what is called an *Acute Angle*, for all angles are acute be their quantity what it will, provided it be less than that of a right angle: on the contrary, if the legs of the compasses be, from this perpendicular situation of one to the other, drawn yet farther back from each other, an angle yet larger than a right one is formed; and this, be its quantity what it will, is called an obtuse angle, for all angles, which have a greater extent than right ones, are obtuse.

It is often necessary to mention an angle of different quantity, as only varying from a right one, or that which is made by the drawing down a perpendicular to an horizontal line; in this case, without any regard to the greater or lesser quantity of the angle, or considering whether it be acute or obtuse, they express its character by the word *Oblique*. An *Oblique Angle* is a term therefore which may be applied to the acute or obtuse, and serves only as its distinction from a *Right*.

ANGLES *alternate*. Two of the eight angles which are made when a strait line intersects a pair of parallel lines. These are the upper internal angle on the one side, and the lower internal angle on the other. *For a farther explication of this, see the article* PARALLEL *lines*.

ANGLES *consequent*. A term used by astronomers to express two angles, which have one

of

of their legs in common to both. This is the case, if a perpendicular line be let fall upon an horizontal line any where between its two ends. This will form two angles, and the perpendicular line will be a leg common to both. These are called Consequent Angles.

Two angles, formed in this manner by a perpendicular let down upon an horizontal line, are to be measured by a semicircle, or one hundred and eighty degrees, for if placing one point of a pair of compasses upon the vertex of these angles, which, like the upright leg, is common to both, you draw a compleat circle, which cuts their legs at the points, the horizontal line will be the diameter of the circle dividing it into semicircles, the one of which will take in no part of the angles, nor have any concern with them; but the other semicircle, taking in all the three points, will measure the Consequent Angles.

From hence results another general demonstration, which is, that whether the semicircle be divided in the middle by the common leg, or in any other part, yet the quantity of the two angles put together is the same. If it be let down perpendicularly, then the two angles are right angles, and consequently they are equal; but if it be drawn from any other part, and the two Consequent Angles rendered ever so unequal to one another in their respective quantities, yet the measure of both of them put together is equal to that of the two right angles; this must be the case, because they have the same semicircle for their common measure, however different in themselves. In the same manner, if the two consequent angles be divided into several more angles, by more lines drawn to the vertical point from different parts of the verge of the same semicircle, the sum of all these several angles put together amounts exactly to the quantity of the two right angles, for the same semicircle still measures them all, and the space which is given to be occupied is not the greater, or the less, because it is more divided.

Men do not see how far the most simple demonstrations will carry them in their consequences. It follows, from what has been already proved, that, if two strait lines are made to cut one another, so as to represent what is commonly called a Saint Andrew's Cross, there will be four angles found about the point of intersection, or the place where the lines cut one another, this point will be the common vertex to them all, and the quantity of these four angles, however unequal respectively to one another, yet, in the whole, will be equal to four right angles made by the same two lines, if placed exactly transverse. This follows from the former observation, for the upper and the right hand angle must be, together, equal to two right angles, because they are consequent; and the left hand and the lower angle are in the same manner equal to two right angles, because they also are consequent; and so the sum of the four, however unequal among themselves, must be equal to that of four right angles. In the same manner also, if there be more than two strait lines brought to cross one another in the same point there will be proportionably more angles made; but in this case, as in the first explication of consequent angles by the semicircle, the sum, or quantity of all these angles put together, will be equal to that of four right angles. And this for the same reason, for as the measure of all those in the former instance was a circle, the measure of all these is a circle.

When, by the intersection of the two strait lines in form of a St. Andrew's Cross, there are formed, as has been already observed, four angles round the point of intersection, which point is the common vertex to them all, any two of the four, which are opposite to each

other at the vertex, are called vertical angles. Thus, where the figure is reprefented upright upon paper, the upper and the lower angle fpoken of, together, are called vertical angles; but this is not confined to thofe, for the term expreffing no more than that the two angles named under it are oppofite one another at the vertex, the right hand and the left hand angle in the figure are alfo called vertical angles, when fpoken of together, for they alfo are oppofite to each other at their vertex. This figure therefore gives confequent and vertical angles.

It is to be obferved, that all vertical angles are equal to one another. This will be eafily feen by making two lines interfect one another in this form of the St. Andrew's Crofs: the upper and lower angles formed by this figure are acute, and they will be found equal to each other, for this is a confequence of their being formed by two ftrait lines, and in the fame manner the right and left hand angles will be found obtufe and equal. The upper angle and the left hand angle are, together, equal to two right angles, for thefe are confequent angles; and, in the fame manner, the two others are equal to two right angles, for they alfo are confequent, and therefore the upper and the lower angle are equal.

ANGLES *equal.* A term ufed by aftronomers and mathematicians, to exprefs thofe angles which are meafured by equal arcs of the fame circle. Thus, if a perpendicular line be drawn from the circumference of a circle, and continued to its centre, and a diameter of the circle be then ftruck, which fhall be exactly horizontal to the firft line, the angle formed by the ftrait line, and one of the femidiameters, and that formed by the fame ftrait line, and the other femidiameter, will be both meafured by the fame, or equal arcs of the circle, or as fome mathematicians exprefs it, they will be fubtened by equal arcs of the fame circle, and confequently they will be equal in quantity. This will be underftood more perfectly by the explanation of the taking the quantity of an angle. Thefe are what are called equal angles. In this illuftration the perpendicular line was a leg common to both angles; this is alfo the cafe in what they call confequent angles, and the term equal is ufed, by way of diftinction, between the one and the other kind; though fome call both confequent.

ANGLES *external.* If two parallel lines be interfected by a ftrait line, whether it is perpendicularly or obliquely, there are eight angles made by the interfection, four of thefe are on the outfide of the two parallel lines, two above the upper, and two below the under one. Thefe four are called the external angles, in oppofition to the four others which are called the internal.

ANGLES *internal.* Four angles out of the eight, which are made when a ftrait line interfects two parallel lines. Thefe are the two which are below the upper parallel line, and the two that are above the lower. The other four are called external angles. *See* PARALLEL *line.*

ANGLES *internal on the fame fide.* This expreffes two of the eight angles which are formed by a ftrait line, interfecting two parallel lines, and they are the upper and the lower internal angle on the fame fide. *For a farther explication of this, fee the article* PARALLEL *lines.*

ANGLES *oppofite on the fame fide.* A term ufed by mathematicians to exprefs two of the eight

eight angles which are formed by a strait line intersecting two parallel lines. These are the upper external, and the lower internal angle on the same side. *See the article* PARALLEL *lines*.

ANGLE, *quantity of*. When there is occasion to take the absolute quantity of an angle, the measure is this: take the vertex or angular point for a centre, and fixing one leg of a pair of compasses there, with the other draw a circle, which will cut the legs of the angle; when this is done the part of the circumference of this circle which is contained between the legs of the angle is to be measured according to the general division of the circle into degrees, minutes, and seconds. 'Tis not of consequence how large or how small the circle be, that is thus sketched with the compasses, provided that it cut the said legs of the angle in the same part, 'tis all that is necessary, for be it larger or smaller, it is divided into the same number of degrees. The figure being drawn strait, the two legs distinguish a determinate part; this is an arc of the cricle, proportioned exactly to the extent of those legs, and when this is done, on the dividing the whole circle into the three hundred and sixty degrees, 'tis easy to see how many of those degrees are contained in the arc, thus separated by, or contained within the legs of the angle, and this gives the quantity of the angle, measured by degrees, minutes, and seconds.

It is a circumstance of importance that the measure is the same, through whatsoever part of the legs of the angle the circle is drawn which is to measure its quantity. If the legs of an angle drawn upon paper be four inches long, and in order to measure the quantity of that angle, a circle be drawn by a pair of compasses, one point of which is fixed at the vertex of the angle, and the other leg separated to the distance of one inch from it; and after this the legs of the compasses be divided to three inches distance, and one point being again fixed at the vertex, another circle be drawn with the compasses thus open; there will be found two circles cutting the legs of the angle at different distances, and two arcs of circles, contained between the upper and the lower part of the legs of the angle, very different in bigness, but belonging to circles, also very different in their diameter, their measure, in proportion of the circle to which they belong, will be the same: that is, the smaller will contain a proportion of the small circle, exactly equal to that portion of the larger circle, which is contained in the larger. Each arc will therefore contain the same number of degrees, minutes, and seconds of a circle, and each will equally give the measure or quantity of the angle, and it will be the same in each to the utmost precision.

'Tis plain to experiment, that the arc of the large circle will be described by the compasses in the same time that the arc of the smaller is; and that if the compasses had three instead of two legs, or when open, to the distance of three inches, if a point issued from the outer leg, which touched the paper at one inch, so that the two circles might be described together; it is evident, that in this case they would both be described in the same time, when the outer point had described the larger circle, the inner point would have described the smaller; and, in the same manner, exactly at the time that the outer point had marked any part of the great circle, the inner one would have marked an equal part of the smaller. Reducing this to the immediate case, when the outer point of the compasses had drawn that arc of a large circle, which extended from one leg of the angle to the other, in the remote part where that circle

cut

cut them, the inner point would be found to have marked also exactly that arc of the smaller circle, which extended from one leg to the other in the part nearer to the vertex in which that smaller circle cut those legs. Thus it appears, that the arc of the larger and of the smaller circle are struck at the same time, and consequently they are and must be equal in their proportion to a circle, and their measure in degrees and minutes, according to the universal division of a circle equal. Each arc of these two bearing the same proportion to its respective circle.

The importance of this truth is very evident, and its use very extensive. As we can carry the legs of this angle with the pen to any extent upon the paper, so in the imagination we can extend them off from it, and that into indefinite space, for the mind allows no bounds in the extension of lines. And 'tis owing to this single consideration, plain, easy, and simple as it is, that we are able to measure out the whole expanse of the universe, and give its place to every star in the skies. 'Tis on this principle that we measure the distance between star and star, and that we are able, by means of a little circle, or a part of a circle of brass, to measure arcs, in those vast circles which we imagine in the starry heavens.

To execute this surprising thing, no more is necessary than this, let a true circle be made of brass, or any other material, and let it be regularly divided into three hundred and sixty degrees. All circles we know are thus divided in order to the admeasurement of their several parts, the largest as well as the least. We have a desire to know the distance of two stars in the heavens. To measure it we are to suppose a large circle drawn in the heavens, the circumference of which cuts those two stars. When this is done, on the principle already laid down for the measuring an angle, that all arcs of circles, which bear equal proportion to their circles, are equal, there will need no more to know at what distance they are from one another, than the knowing at what distance are the lines on which they are viewed along this circle of brass, for all circles being alike, these lines are the legs of an angle on the brass, which being, by the imagination, extended into the heavens, are carried beyond those stars, or at least to them. Thus, their distance is measured by an arc of a circle which measures the quantity of a part of an angle, and the quantity of all parts of the same angle being equal in their proportion to a circle, or their number of degrees, minutes, and seconds, the two lines, along which they are viewed, giving the two legs of an angle on the brass circle, they are instantly measured by a certain number of the degrees marked on this circle, and just so many degrees of a greater circle, that is just so many degrees, minutes, and seconds distant are the two legs of the angle, where they reach the starry heavens, that is, just so many degrees distant are those two stars from one another.

So easy is the measuring out the heavens, and ascertaining the places of the stars, when it is brought to practise, difficult and strange as the attempt appears to the uninstructed; and on such plain and such easy methods of working does it depend.

The method of doing it is this; a circle of brass is divided into three hundred and sixty degrees, and the stars, whose distance is to be determined, are viewed from its centre. The eye being placed there, is directed to one of the stars, thro' two sights placed in a line reaching from that centre to the circumference. The other star is then viewed by the eye still placed in the centre of the brass circle, thro' two sights in a moveable ruler, which is brought to answer in a line to the second star, as the line itself, through which the first was viewed, did

to it. The line and the ruler now form the two legs of an angle, at the vertex of which the eye is placed which views the two ſtars; and the imagination continues thoſe legs to thoſe ſtars. If they were in reality ſo continued, and a great circle was ſtruck in the heavens cutting them at the place of the two ſtars, as the braſs circle does at the place where they meet its circumference; the whole would be juſt in the ſituation of the four-inch angle made upon the paper, it would be an angle with its legs extended to a great length, and cut in two places by two circles, the one drawn near the vertex, the other at a great diſtance from it. It has been already obſerved, that the two arcs of circles contained between theſe legs at the different diſtances, although very different in their abſolute, would be altogether the ſame in their relative dimenſions; that is, the ſmaller would contain juſt as many of the three hundred and ſixty degrees with their minutes and ſeconds, as the larger, and therefore its quantity, as part of a circle, would be the ſame: the caſe is juſt ſo with theſe two circles, the one ſuppoſed to be made in the heavens, the other actually formed in the braſs. Although the arc of the greater would be vaſtly large in proportion to that of the leſſer, or braſs circle, yet they would be both arcs of the ſame quantity in proportion to the general diviſion of a circle; and the one would contain as many degrees as the other. It is therefore only counting the number of degrees, which the arc of the braſs circle contained between the line and the ruler has in it, and juſt ſo many muſt there be in that above in the heavens; conſequently the figures marked on the edge of the braſs circle, and declaring how many degrees there are in that arc contained between the line and ruler, tell how many degrees of a circle the two ſtars, which were the object of the obſervation, are from one another.

The mathematical inſtrument-makers have an inſtrument prepared for this purpoſe, which they call a *protractor*. This is a ſemicircle of braſs divided into degrees, and, according to its ſize, into ſmaller diviſions under theſe. To meaſure an angle by this inſtrument, the central point of the protractor is to be laid upon the vertex of the angle, and a ſemidiameter of it upon one of the legs of the angle running from that vertex; the other leg then falls upon another part of the marked edge of the inſtrument, and thoſe marks give the quantity of the angle, or the number of degrees contained in it. Nor is the meaſuring of angles, already made, all the uſe of this inſtrument. 'Tis eaſy to ſee, that it will ſerve for the exact and accurate drawing of angles of any number of degrèes. If a ſtrait line be marked upon paper, and the ſemidiameter of the protractor be laid evenly upon and along it, ſo that its central point falls upon one end of the line, you have then a vertex and one leg of an angle. While the protractor lies thus on the paper, make a mark with a pen at the diviſion you chuſe, ſuppoſe it fifty, or whatever; cloſe to the edge of the protractor. When this is done, take away the inſtrument and draw a ſtrait line from this mark to the extremity of the firſt line which had lain at the centre of the circle; and this ſecond line makes the other leg of an angle of the fifty degrees required, which you have now compleat.

ANGUILLA, *the Eel*. A conſtellation now firſt offered to the aſtronomical world, and compriſing a number of unformed ſtars, ſome of them very conſpicuous, over the heads of Capricorn and Sagittary. It is an aſteriſm of conſiderable extent, and, in proportion to the ſpace that it occupies in the heavens, is not ill furniſhed with ſtars. The figure is that of the

common

common eel in that convoluted ſtate in which it is uſually ſeen when in motion. But the contortions of its body are not many nor violent, ſo they make it very happily compriſe the ſtars.

The conſtellations, between and among which the Anguilla is placed, are the Equuleus, the Dolphin, the Eagle, and the Serpent of Ophiucus. Theſe are above and before it. And it ſeems running from Aquarius, and over the heads of Capricorn and Sagittary.

The conſpicuous ſtars in this conſtellation are thirty-ſeven, and ſeveral of them are very large and bright ones; in general they are ſo placed as to mark the figure, and make it very diſtinguiſhable in its whole courſe. They are diſpoſed in the following manner; there is one at the tip of the ſnout, or verge of the mouth of the Eel, and, at ſome diſtance behind this, there are two at the ſides of the upper part of the head, which ſtand as eyes; theſe three are all very bright and conſpicuous; that at the mouth is the largeſt of them. At the firſt bend of the body there are three, all near the outlines, two are near the upper, and one at the centre of the bend at the under: this is a large ſtar, as is alſo the firſt of the others; the more remote is ſmaller, and, when nicely examined, is found to be a double ſtar, or compoſed of two leſſer ones. Beyond theſe are four more in a kind of cluſter, one is in the out-line near the bend, the other three are at a little diſtance behind and above this; they fall in nearly a ſtrait line from the upper out-line; the two upper are ſmall, the lower is a very large and bright ſtar. At ſome diſtance behind theſe is one little ſtar in the lower out-line; at a diſtance behind this are three in the body in an oblique line, all ſmall; beyond theſe are three other alſo ſmall, more diſtant from one another, and in a more oblique line; and the middle one of theſe is a very large and bright one. Beyond theſe ſtands a ſingle ſmall ſtar in the upper out-line; there is alſo, in the upper out-line, a very large one. At a diſtance behind theſe are two in the body; and at the next bend a large ſtar in the lower, and a much larger in the upper out-line. Beyond theſe are three near the lower out-line; then three more, two near the lower and one near the upper; then two more both near the lower; and laſtly, two at the extremity of the tail, both ſmall. Thus is the courſe of this conſtellation diſtinctly marked from near the body of the Serpent, where the hand of Ophiucus has hold of it, to the ſhoulder of Aquarius, and all the way in a diſtinct manner.

ANGUINITENS. A name by which ſome of the aſtronomical writers have called the conſtellation, which is more generally named Ophiucus and Serpentary. This is a name properer by far than thoſe of the ſeveral Greek heroes, by which it is called from an opinion of its having been deviſed in honour of their exploits; ſince 'tis certain the Greeks received the figure from the Egyptians, who knew nothing of their hiſtory. The old writers called the kneeling figure in the ſkies *Engonaſin*, expreſſing a man kneeling, and this Anguinitens is a proper name for the figure of a man ſtruggling with a ſnake, it expreſſes all that need be conceived, and, like the other names Ophiucus and Serpentarius, does better than that of Carnabos or Hercules, as ſome have called this as well as that kneeling figure. *See* OPHIUCUS.

ANGUIS, *or* ANGUIS ÆSCULAPII. One of the conſtellations of the northern hemiſphere, more uſually known by the name of Serpens, or Serpens Ophiuci. It has obtained its name of Anguis Æſculapii from the

Grecian

Grecian story, that makes Ophiucus, between whose legs the serpent is placed, and who seems victorious over it, to be Æsculapius. They say that his victory over this serpent meant no more than his power of healing the bites of those venomous animals; and they tell us, he was raised up into the skies, with this trophy of his art, under his feet, at the request of Apollo, by the hand of Jupiter. The Greeks were ready at invention; and this is not the only proof they have given us of it in this single constellation. They received the figure of this, among others, from the Egyptians, by whom they were taught the rudiments of that astronomy, which they afterwards raised into so noble a science. They gave names as they pleased to those figures of the heavens, which Thales, and others, brought among them from these people, but they did not always agree upon the story. This Serpent and Ophiucus, sometimes they made Carnabas killing one of Triptolemus's dragons, sometimes Æsculapius, as already observed, and sometimes Hercules killing the famous Lydean serpent of the river Segaris. *See* OPHIUCUS.

ANSATED. A term used by some of the earlier astronomers, to express an appearance of the planet Saturn, when it seems to have a handle on each side. One of the first disoveries of the telescope, when brought to a tolerable degree of perfection, was that Saturn did not appear like the other planets. Galileo in 1610 supposed it composed of three stars, a larger in the middle, and a smaller on each side, and he continued his observations till, as himself observes, the two lesser stars disappeared, and the planet looked like the others. Other astronomers also a little after observed, that this ansated appearance of Saturn was not continual or permanent, but that he often lost these handles, or ears, and was round and simple, like the other planets. What Galileo, and his successors, took for distinct stars, or for the handles affixed to this planet, were parts of the ring of that planet on each side.

Saturn, which is at a vast distance from the sun, beside five satellites, which serve to him as moons, has a lucid ring, surrounding his globe at a small distance: this is probably formed of a great number of satellites, performing their revolutions about his globe in circles, a little remote from one another. Howsoever that be, we sometimes see this ring considerably broad, and sometimes narrow, and finally at other times, when it presents only an edge to us, it quite disappears, that edge not reflecting light enough to make it visible at so great a distance. When the ring appears tolerably broad, it represents the handles, or the two stars, described by Galileo and others. When the ring is in such a situation as quite to disappear, Saturn looses his ansæ, or ears; or his two attendant stars, as Galileo called them, disappear; and he is viewed like the other planets.

ANSER, *the goose*. A constellation, or rather a part of a constellation, in the northern hemisphere. The whole is the Fox and Goose, *Vulpecula et Anser*; and this is one of the new constellations of Hevelius, formed by that author out of the stars, not comprised under the out-lines of the antient figures, and called Stellæ Informes, or unformed stars. This constellation is placed over the Eagle, with a little one called the Arrow between, and seems running toward Hercules. This is one of those added of late days to the forty-eight antient asterisms, to the great advantage of astronomers. *For the stars comprised in it, see* VULPECULA *et* ANSER.

ANSER AMERICANUS. A name by which ſome of the late aſtronomical writers have called the new ſouthern conſtellation the Toucan. It is a very ill name; for this bird is not at all of the gooſe kind. The conſtellation is a ſmall one toward the ſouth pole, ſituated between the Phœnix and the Indian, and compoſed of nine ſtars. *See the article* TOUCAN.

ANTARCTIC *pôle*. The ſouth pole. *See the articles* POLES *of the world and* CIRCLES *of the ſphere*.

ANTARCTIC *circle*. A term that we meet with very frequently in the writings of the old aſtronomers. They expreſs by this the largeſt parallel that is kept entirely below the horizon of any place in the north latitude. This parallel is what they called the Antarctic circle, as on the other hand the largeſt parallel that was ſeen entire above the horizon they called the Arctic circle. And as they found that whatever ſtars were contained within the compaſs of the Arctic circle could never ſet, but were carried about in their whole revolution above the horizon, and always to be ſeen; ſo they comprehended within the Antarctic circle all thoſe ſtars which never could riſe in that place, but were, in their whole revolution, carried about below the horizon.

ANTECANIS, *the little dog*. A name given to that conſtellation becauſe of its riſing before Sirius. The Egyptians were the inventors of both theſe conſtellations; and it is plain that they invented theſe in Egypt, although it is evident they brought many of the others with them from ſome other place. The ſign Virgo betokened harveſt, and the figure of a maid or woman of the harveſt-work, with an ear of corn in her hand, was made to receive thoſe ſtars which occupied the ſpace in the heavens, which the ſun entered at the approach of harveſt: in the ſame manner Aquarius, a human figure, powering water out of an urn, was made the conſtellation at the entrance of the ſun into which the rain and bad weather of winter came on. This was the meaning of thoſe figures, and thoſe figures the Greeks had from the Egyptians; but they were not deviſed in Egypt, for they do not ſuit the ſeaſons of that country. In Egypt the harveſt is not in Autumn, but in March or April; and their winter is the fineſt ſeaſon of the year: neither can the urn have any ſignification, ſince they have there no rain at all. The Egyptians therefore, who were a colony, ſent off from ſome larger nation to the Nile, carried with them theſe conſtellations, which they had found eſtabliſhed in their original habitation, and which ſuited that, as it does all other countries of the temperate zone; but not that place, where they now were.

This is palpably the caſe with reſpect to theſe and to ſome other of the old forty-eight conſtellations, probably with moſt of them, but that there were ſome invented while they were in Egypt is certain. This little dog and the larger, are two of them, and they afford convincing proofs of it, ſeeing they relate to things which could be obſerved only in Egypt, and which concerned that country only. This ſhews us, that they were not idle aſtronomers, but that ſome part at leaſt of what the Greeks obtained from them was of their own invention there. They had nothing ſo worthy of their obſervation, nothing ſo important to them while in Egypt, as the riſing of the Nile; for it was the mud left by this river on which they ſowed the corn for their early harveſt, and on this depended all their encreaſe. They found that the time of the ſun's being under Leo,

that is the time when a certain ſtar of the firſt magnitude, the brighteſt and moſt conſpicuous in the whole heavens, emerged out of his rays, and appeared before day-break, was the period of the waters beginning to riſe. The Nile was called Siris, and they called this ſtar, which had ſome relation to its ſwelling, by a name derived from that of the river Sirius. When they had occaſion to form this into a conſtellation, they choſe the watchful and the faithful dog for the creature. They accounted their year from the firſt riſing of this ſtar, which was their neceſſary day, and they paid divine honours to the ſtar, and to the animal, under whoſe figure they had arranged the conſtellation, by the name of Anubis. They obſerved a couple of other ſtars, which always aroſe a little before the others, and theſe they alſo remarked with reverence, as the fore-runners of the more important. They repreſented theſe under the figure of a little dog preceding, or leading in the greater; and the Greeks received one and the other from them, continued the figures, though unacquainted with their meaning, and that the origin of the ſcience might ſeem to have been with them, gave parts of their own hiſtory or fable by way of explanation to them. They make the little dog one of the creatures of that uſeful ſpecies belonging to the huntſman Orion, and the greater the famous guard of Europa, which afterwards became the follower of Cephalus, and, after being turned into ſtone at Thebes, was taken into the ſkies.

ANTECEDENT *quantity*. A term uſed to expreſs that of two numbers, or qualities, which have a ratio to one another, which is placed firſt. If both are equal, the ratio is of equality. *See* RATIO.

ANTINOUS. A name of one of the conſtellations of the northern hemiſphere. It is of a middle period, much older than thoſe which we call the new conſtellations of that hemiſphere, theſe having been made by Hevelius out of the unformed ſtars, and much later than the old forty-eight. It has been formed in the manner of thoſe, from ſome ſtars left uncompriſed in the out-lines of the other conſtellations, and added to the number. The perſon repreſented is Antinous, the favourite of Adrian, a youth of fine ſhape and figure, and the ſtars, out of which it is compoſed, have been uſed to be reckoned among the unformed ones of the Eagle. It is hence that the old writers compriſe all the ſtars belonging to this conſtellation under that of the Eagle; and while ſome of the moderns count them ſeparate, others follow the antients, and making the Eagle and Antinous one conſtellation, count them together.

Antinous is a conſiderably large conſtellation, and in proportion to its extent, it comprehends a conſiderable quantity of ſtars, and ſome of them very conſpicuous. It is repreſented in the ſchemes of the heavens in figure of a naked youth, of very good proportion, and in a poſture that is neither ſtanding, ſitting, kneeling, nor lying, but ſeems as if he were falling through the air. The whole figure is repreſented naked, the head is covered with hair, and the body bulky rather than thin, the legs are bent backwards, and the arms expanded. The conſtellations between which Antinous is placed are the Eagle, Ophiucus, Sagittary, and Capricorn. He is placed juſt under the Eagle, and at ſome diſtance over the head of Capricon, the hair of Antinous comes juſt under the throat of the Eagle, his left hand and left foot are bent at a ſmall diſtance from the tail of Ophiucus and the Serpent. His right knee bends down towards the flowing mantle of Sagittary, and the horns of Ca-

pricorn

pricorn are about of an equal diſtance from it. Antinous does not occupy the whole ſpace between theſe, nor does it comprehend all the ſtars there; but there are a great many of them very happily compriſed in it. The ſtars of conſpicuous ſize in Antinous are counted by Hevelius to be nineteen: of theſe, the moſt conſiderable are four in the right arm, one in the left, and two in the left hand; there is alſo a very bright one at the bottom of the neck, and one on the right ſhoulder; there are three in a cluſter on the left ſide, one on the belly, and three on the left hip. There are alſo two on the right thigh, one on the left leg, and three on the left foot; one of theſe, which is at the great toe, is a very conſiderable and bright ſtar. The whole conſtellation is very well marked, and eaſily diſtinguiſhed in the heavens.

ANTÆCI. One of thoſe terms which the antients uſed to expreſs the different ſituation of parts of the globe, by the relation which the ſeveral inhabitants bore to one another. Thus when people lived ſo near to one another, that there was no obſervable difference between the horizons of the two places, they were called Synæci, neighbours; and when they lived in oppoſite parts of the ſame parallel, ſo that they had the ſame courſe of ſeaſons, but an oppoſition of day and night, it being noon at the one, when it was midnight at the other, they were called Periæci, oppoſites; and when two people lived in places that lay in parallels at an equal diſtance from the equator, but on the oppoſite ſide, they were called Antæci. Though theſe people live, the one in the north, and the other in the ſouth, yet being at equal diſtance from the line, they have the ſame ſeaſons, but at different times of the year, and their encreaſe of days and nights are equal. There is another thing alſo in which they agree, that is, the elevation of the pole is the ſame in both; but in one the north pole, and in the other the ſouth pole is elevated. It follows, that as the people who live in the oppoſite points of the ſame parallel, have midnight at one, when it is noon in the other; ſo theſe who live in parallels equally diſtant, though on the two ſides of the equator, have the longeſt day in one, when it is the ſhorteſt day at the other; and that what is the beginning of ſummer at one, is the beginning of winter at the other; and ſo vice verſa.

ANUBIS. A name by which ſome of the old aſtronomers have called the Dog-ſtar; it is of Egyptian origin; for they worſhipped this ſtar under that name. They confounded their god Thoth, which was the Grecian Hermes or Mercury, with this ſtar, and paid divine honours to both, under the form of a dog, with a man's head, or a man with that of a dog. This was one of the earlieſt pieces of idolatry. They deified the Nile, to the ſwelling of which river, they owed all the fertility of their land; and as they ſaw the Nile began to ſwell at the time of the riſing of this ſtar, they ſuppoſed it influenced by it, and therefore paid it divine honours. They called it alſo Sothis and Sothi, holy; and its name Sirius was derived from one of the names of the Nile, which is Siris. This was evidently one of the firſt ſigns taken notice of by mankind. We find Homer and Heſiod, who mention only four or five of the conſtellations, always taking occaſion to do honour to Sirius, and making it one of that number.

ANWA. A name given by many of the writers in aſtronomy, who affect odd terms, to the conſtellation Bootes. It ſignifies the Caller-out. The Arabs uſe it as one of their names

names for the conſtellation, and ſuppoſe him the driver of the oxen which drew the great waggon; ſuch was originally the name of the Great Bear, or Urſa Major.

APHAAK. A name by which ſome, who are fond of uncommon words, call the conſtellation Draco. It is one of the Arabic names, and in that language ſignifies a ſerpent.

APIS, *the bee.* One of the conſtellations of the ſouthern hemiſphere. It is one of the leaſt in the whole heavens, and contains a ſmall quantity of ſtars. It is one of thoſe which the late aſtronomers have added to the forty-eight old aſteriſms.

The conſtellations, between and among which the Bee is ſituated, are the Royal Oak, the Chamelion, the Bird of Paradiſe, the Triangle, and the Centaur. The laſt is at the greateſt diſtance, but none of them ſerves ſo well to aſcertain the abſolute place of the Bee. The Royal Oak is on one ſide, and the Triangle is almoſt oppoſite to it on the other, and neither at any great diſtance. The under part of the body comes near the head of the Chamelion, which is turned towards it with the belly upwards, and the hinder feet of the Centaur are over its head; the point of the croſs, which the Portugueſe have added to the conſtellations, and which is between the feet of the Centaur, is almoſt juſt over the head of the Bee.

This little conſtellation is very aptly repreſented in the drawings of the heavens, but it is not ſo well expreſſed by the ſtars that are compriſed in it; all that the authors of it meant by the figure, ſeems to have been, that, having a very ſmall cluſter of ſtars to deſcribe, they choſe as little a figure as they well could to place them in.

There are only four ſtars in the conſtellation of the Bee, or Fly, for it is indifferently called by either name; and as the creature is uſually repreſented one of theſe, is placed in the centre of the head, and another on the body toward the tail, and on one ſide. The other two are diſpoſed on the wings: one of theſe is near the top of one wing, and the other is near the bottom of the other.

APOGEE *of the ſun.* That part of the animal orbit, in which the ſun is at the greateſt diſtance from the earth. To underſtand this properly we are to know that the earth moves round the ſun, not in a circular, but in an elliptical orbit. The ſun is placed in one of the foci of this ellipſis. What is called the ſun's apogee, may more properly be termed the earth's aphelium, for the earth is truly a planet, and is to be ſpoken of as ſuch; however, to uſe common terms and common appearances, we ſhall underſtand that, in conſequence of the earth's annual revolution round the ſun in this ellipſis, the ſun will appear to thoſe on the earth, as if it revolved round the earth in ſuch an orbit. Now as the ſun is in one of the foci, the diſtance in one part of the orbit is much greater than in the other. That point of the ecliptic, when the ſun is moſt diſtant from the earth, is called its apogee, or if we ſpeak of the earth, its aphelion. Thus alſo, when the earth is in that part of her orbit which is neareſt to the ſun, we call it her perihelion; or, if we ſpeak of the ſun, we call that point of the ecliptic its perigee.

APOGEE *of the ſun, its motion.* After we have determined by the proper methods the figure of the orbit, which the ſun deſcribes in its revolutions, and the ſituation of its apogee and perigee, it will remain to enquire whether the poſition of that orbit, with reſpect to the fixed

fixed points of the eliptic being variable, so that there will happen no change in any period of time, or when it be subject to some degree of variation. Ptolemy, when he had found that the sun's apogee answered to five degrees and thirty minutes of Gemini, where Hipparchus had determined it two hundred and eighty years before, judged it to be immoveable, and that the position of the orbit of the sun was not liable to any variation. There appeared reason for such a determination on such circumstances; but there only appeared reason. There required more time for the determing in this point. The astronomers, who came after Ptolemy and Hipparchus, did not find the sun's apogee to answer to the same point in the heavens at which they had placed it, and were obliged to allow that the line, which passes through the centre of the earth, and the orbit of the sun, changes its position: but although they agreed as to the motion, they have been greatly divided in their opinions as to the direction in which it was made. Some of them, on comparing with one another the observations of astronomers of different periods, according to which the apogee of the sun seemed to change place by a motion made at some times in a direction according to the order of the signs, and at others exactly in a contrary way, or directly against that order, were of opinion, that this motion was not absolutely progressive, but direct and retrograde, conformable to that which they discovered, without much better understanding the nature of it, in the superior planets.

Other of the astronomical writers observing that, according to a vast number of their own observations, the sun's apogee continued to advance in a direction according to the order of the signs, have attributed those inequalities, which others had observed in its motions, to the difficulties which are in the attempt to determine exactly what is the situation of the apogee, and have concluded, that the apogee of the sun had in reality a determinate and regular progressive motion, according to the order of the signs.

As this motion is very slow, and consequently is very difficult to be discerned in the space of any small number of years; it is certainly necessary, in order to understand it truly, and to determine its quantity, to have recourse to observations made at a great distance of time from one another, for those of any one man's life are unequal to it, and it is idle to trust to them, or calculate from them. The observations of Ptolemy and Hipparchus are the earliest that we have any acquaintance with, that can be depended upon; but as, according to Ptolemy's account, the sun's apogee was at his time in the very same place in which it had been in the days of Hipparchus, although an interval of two hundred and eighty years had fallen between, which ought to augment the quantity of its motion nearly a fifth part, it may be proper to examine the matter fully. Waltheus of Nuremberg has left a great number of observations of the sun made in the year 1503, many of which he has marked, as made with the most perfect care and precision. We may chuse out of these such as appear to agree best with one another, and to represent the motion of the sun the most conformable to what we see it at present. When we have from these determined the apogee and perigee of the sun, according to the established rules by correspondent observations of the same interval of time, we may proceed to judge.

On the eighteenth of March in 1503, the true place of the sun was $0^s. 6^\circ. 32'. 6''$. and on the ninth of May following it was $1^s. 27^\circ. 7'. 5''$. this gives the true motion of the sun in the space of fifty-two days to be $50^\circ. 34'. 59''$. On the twenty-sixth of June, in the same year, the

the true place of the fun was 4ˢ. 11°. 25′. 16″. and on the fixteenth of September, in the fame year, it was 6ˢ. 2°. 0′. 41″. This comparifon gives alfo the true motion of the fun in a fucceeding fpace of fifty-two days to be 50°. 35′. 25″. The difference is, that the true motion of the fun, in fifty-two days from the eighteenth of March to the ninth of May 1503, was twenty-five feconds of a degree lefs than that of fifty-two days of the fame year from July to September. Notwithftanding that, this difference is fo little that it would be very natural to attribute it to the mere error and uncertainty of calculations; yet if we will chufe to take account of it, the refult will be, that the motion of the fun being lefs in the firft equal fpace of time, than in the fecond, at thefe periods; the fun, which diminifhes the fwiftnefs of his motion as he approaches to his apogee, was nearer to the earth at the time of the two former, than it was at the time of the two later obfervations, and this in a quantity, which, on computation, we fhall find to be fourteen minutes of a degree. Now valuing thefe fourteen minutes from the true place of the fun, as feen on the ninth of May at noon at 1ˢ. 27°. 7′. 5″. we fhall have 1ˢ. 26°. 53′. 5″. as the true place of the fun for the time when he was at the fame diftance from his apogee, as he was on the twenty-fixth of July at noon, when he was found 4ˢ. 11°. 25′. 16″. the difference is 2ˢ. 14°, 32′. 11″. the half of which 1ˢ. 7°. 16′. 6″. being added to 1ˢ. 26°. 53′. 5″. gives the true place of the apogee of the fun in the year 1503 to be at 3ˢ. 4°. 9′. 10″.

Now, according to obfervations taken, with the utmoft care, in France, and publifhed in the memoirs of their academy, the apogee of the fun was found in the year 1738, to be at 3ˢ. 8°. 19′. 8″. the difference is 4°. 9′. 58″. and this difference is the meafure of the motion of the fun's apogee in the interval of two hundred and thirty-five years. At this rate the fun's apogee moves at the rate of one minute and four feconds of a degree in a year. Here is therefore fomething of a certainty eftablifhed on fuch principles that it cannot be difputed; and from this we may reafon.

If we compare the fun's apogee as its fituation was determined by Hipparchus one hundred and forty years before the birth of Chrift, at 5°. 30′. of Gemini, with the fituation of it, according to the obfervations made in France in 1738, which place is at 8°. 19′. of Cancer, we fhall find, that, in the fpace of 1878 years, (for that is the interval between the two calculations) the fun's apogee has had a movement of 32°. 49′. and this refolved into years, is at the rate of 1′. 2″. 54‴. each year. This fame movement of 32°. 49′. being divided by 1598 years from the time of Ptolemy to that of the French obfervations, will give the annual movement of the fun's apogee at 1′. 14″. The quantity of the motion of the fun's apogee, which refults from a comparifon of the different obfervations of Waltheus, agrees more exactly with the obfervations of Hipparchus, than with thofe of Ptolemy. This laft author indeed, if we examine the matter ftrictly, will be feen to have been afraid of departing from the determinations of Hipparchus, not only with regard to the apogee of the fun, but alfo with refpect to the obliquity of the ecliptic. The movement of the fun's apogee, which refults from a comparifon of the obfervations of Hipparchus, is alfo more conformable to the fituation of it, as determined by different aftronomers, in the intermediate time.

In order to eftablifh the principles of a rational calculation on this head, it may not be improper to trace the fituation of the apogee at different times, as aftronomers of different ages have placed it: from this we fhall be able to determine what is its annual motion according to each. Hippar-

Hipparchus, one hundred and forty years before Christ, placed it at five degrees thirty minutes of Gemini; Ptolemy one hundred and forty years after Christ, at the same place, five degrees thirty minutes of Gemini; Albategnius in 883 at twenty-two degrees seventeen minutes of Gemini; Arzachel in 1706 at seventeen degrees fifty minutes of Gemini; Alphonsus in 1252 at twenty-eight degrees forty minutes of Gemini; Waltheus in 1503 at four degrees nine minutes of Cancer; Copernicus in 1515 at six degrees forty minutes of Cancer; Tycho in 1589 at five degrees thirty minutes of Cancer; Kepler in the same year at five degrees thirty-two minutes of Cancer; Riccioli in 1646 at seven degrees twenty-six minutes fifteen seconds of Cancer; and Cassini, at the Royal Observatory in Paris, in 1738, at eight degrees nineteen minutes and eight seconds.

On comparing these observations of the earlier astronomers of different periods with this last of the French, we shall find that the annual movement of the sun's apogee is, according to Hipparchus, $1'.\ 3''$. according to Ptolemy $1'.14''$. according to Albategnius $1'.7''.\frac{1}{2}$. to Arzachel $1'.\ 51''.\ \frac{1}{2}$. to Alphonsus $1'.10''$. to Waltheus $1'.\ 4''$. to Copernicus $0'.\ 25''$. to Tycho $1'.7''$. to Kepler $1'.6''.\frac{1}{2}$. and according to Riccioli $0'.\ 34''$. What honour must it do to the old Hipparchus to find that his observations are those which, of all the number, bring this motion nearest to those of Waltheus in the calculation. The character of Waltheus's is sufficiently established.

That the apogee of the sun has a motion, and a determinate one, is clear from this: but these varieties in the quantity of the apogee and perigee of that luminary, or of the aphelium or perihelium of the earth, for that is the more perfect term, resulting from these observations, according to which the motion is greater or lesser fifty seconds, has given rise to an opinion, that the orbit of the earth is directed at all times to the same point of the heavens; and that the apparent motion of the line, which passes through its aphelium and perihelium, is caused in the same manner as that of the fixed stars, by the procession of the equinoxes, or the movement of the pole of the earth about that of the ecliptic.

APOLLO. A name by which some have called the constellation Gemini. They supposed Apollo and Hercules, the two figures of which it is composed, and they name it from the principal. Others, among the Greeks, call them Triptolemus and Jasin, and most Castor and Pollux. *See* GEMINI.

APUS. The Bird of Paradise; one of the new constellations of the southern hemisphere, called also the Indian bird, Avis Indica. It is but a small constellation, but proportionately to the space it occupies in the heavens, it is not very much crowded with stars. It is drawn in figure of the bird generally know by the name of Bird of Paradise, with a long neck, a small body, and a very large tail, no feet are given to it, and the bird was at one time believed to have none; it had thence its name Apus. People who brought it into Europe, accustomed themselves to pull off the legs, in order to favour the absurd opinion of its living at all times in the air. The head is in this figure protended forward, and the tail turned a little upwards. The constellations between and among which the Bird of Paradise is placed, are the Peacock, the Altar, the Triangle, and the Camelion, the tail of the Hydrus is opposite, and almost parallel to it on one side, but at a great distance. The lower part of the tail of the Peacock comes very near to the head of the Bird of Paradise, the smoke from the Altar is at its top, just opposite to the beak of that bird, the corner of

the Triangle comes close almost to its neck, and its tail almost touches the back of the Camelion.

The stars in the constellation Apus are eleven, and they are very well disposed to be in themselves conspicuous, and to make the figure understood. There is a very bright and considerable one just at the base of the beak, a small one at the lower part of the head, two near one another on the breast, four in the lower part of the tail disposed in a curve, whose hollow part is toward the beak of the bird, and one at the tip of the tail, where it is turned up. By these the constellation is as distinctly characterised as any can be, and it were well if all those in the northern hemisphere had as much respect paid to the figure in the constellation. But there is a plain reason for this pre-eminence in these new ones. The astronomers, who formed the stars unto these new constellations, had no other consideration in the choice of the form but what creature would best receive them as they stood in the heavens; but, with regard to the old forty-eight constellations, it was otherwise. The Egyptians, who formed them, were a people fond of hieroglyphic language, and in all things making use of it. When they formed a constellation, their business was not to select such an animal as would, by its figure, be most fit to take in that quantity of stars, but they fixed upon one that would convey some meaning. Thus, to denote the stars into which the sun entered at the time of lambs and calves being brought forth, they did not see what creatures form most aptly would suit the stars in that space; but they placed there the Ram and the Bull, the fathers of the flock; and fixed the stars they found in that space as well as they could into one or the other of these figures. In the same manner, for those stars which occupied the space in which the sun's heat was most furious, they chose a lion, and so of the rest. 'Tis no wonder therefore if the stars do not well mark out the lines of those figures under which they are comprised in the old constellations: but the authors of the new would be unpardonable if they had not fixed upon such figures as would most properly mark out by the situation of the stars; seeing they had no other care. 'Tis not always however that they have succeeded so well as might be wished.

AQUARIUS. One of the constellations of the northern hemisphere, famous among the antient astronomers. It is one of the forty-eight old asterisms, and one of the twelve signs of the zodiac. It is a large and very conspicuous constellation, comprehending in its extent a great number of stars.

Aquarius is represented in the schemes of the heavens as an human figure, a man in a posture like sitting naked, except for a robe flying about his waist, and holding up in his left hand a part of that robe, and in his right hand an urn or pitcher, out of which he pours water, which runs in a stream, forming a kind of river, down to his right foot. The face is drawn as that of a young man, and the figure in general not badly executed.

The constellations between and among which Aquarius is placed, are the Whale, the Fishes, Pegasus, the Dolphin, and Capricorn. The tail of the Whale comes toward a level with his right knee, but it is at some distance, and the stream of water from his urn is between; the fishes are placed one very near the urn in his right hand, and the other close to the left foot, the line which ties them running by the river, the head of Pegasus, though in a reversed direction, comes very near to that of Aquarius, and the neck hides the lower part of the urn, the Dolphin is

at a conſiderable diſtance over his left ſhoulder, and Capricorn is ſo cloſe before him, that his tail comes up to the body of the figure on the left ſide.

The old writers from the time of Hipparchus allowed forty-five ſtars to this conſtellation. Ptolemy ſets down ſo many, and he has been followed by all authors to the time of Tycho Brahe. That judicious aſtronomer has ſet down only forty-one: but Hevelius, who followed him, gives forty-ſeven, and Flamſtead has enlarged the number to an hundred and eight. Theſe are very equally diſperſed over the body of the figure, the urn, and the river, and are ſo much alike in general in ſize, that the conſtellation is diſtinguiſhed by this very equality.

Among them all there is not one ſtar of the firſt, nor one of the ſecond magnitude. It is uſual with ſome to talk of one of the firſt magnitude at the bottom of the water, but it is more cuſtomary to account that to the conſtellation Piſcis Anſhalis; it is the famous ſtar known by the diſtinct name of Fomehaut, and is placed in the mouth of the ſouthern fiſh. The largeſt ſtars, properly ſpeaking, in the conſtellation Aquarius, are only of the third magnitude, but there are five or ſix of theſe, and they are ſufficiently conſpicuous. One is in the right ſhoulder, and another in the left, one in the hinder arm, one in the leg, and one in the hips, called by many only a fourth in magnitude. The reſt are in general ſmall, ſome of the larger of them are in the robe, and about the middle of the figure.

The Greeks, eager to have aſtronomy ſuppoſed of the origin of their country, have not failed to adapt ſome part of their hiſtory, or fable, to all the figures of the conſtellations, that it might appear to others they were of their invention: but this was only a pretence. The conſtellations were brought to them from among the Egyptians, and they are ſo far from knowing any thing of their true hiſtory, that they do not comprehend their meaning. They tell us, that this ſign of Aquarius is a commemoration of Ganymede, a Trojan boy, whom Jupiter, by the help of an eagle, carried off from mount Ida, and raiſed firſt to the honour of being his cupbearer, and afterwards dignified with this place in the ſkies. They call the urn, and the pouring out of liquor from it, an emblem of his office: but others are not contented with this ſtory. They will have the figure to be that of Deucalion, and the water running from the urn in ſo large a ſtream, to be a commemoration of that deluge, which in his time overwhelmed all Theſſaly, and which has by ſome been ignorantly or deſignedly confounded with the univerſal deluge in the time of Noah. The Greeks deſtroy the credit of their own accounts on theſe ſubjects by their diſagreement in them, while ſome called the conſtellation Aquarius Ganymede, and others Deucalion, two perſons as different, as could well have been choſen, from one another; there have been others who contradicted both, and made it Cecrops. They tell us, that this is a name of greater antiquity by far than the others, and that the urn and the water uſed to be poured out in ſacrifices to the gods, and that Cecrops reigned in theſe early ages. They ſay this conſtellation repreſents the good old king pouring out the urn of thankſgiving.

We are no more to regard one of theſe than the other, the Egyptians, and not the Greeks, invented the conſtellations, at leaſt they are ſo early; and therefore neither Ganymede of Troy, nor Deucalion of Theſſaly, nor even their antique Cecrops, were in being when they were deviſed. The Egyptians characteriſed the ſeveral periods of the year by animals, whoſe figures they placed in the zodiac: the

the heat and fury of the summer-sun was signified by the raging lion, the time of harvest, by the sun-burnt maid of the field, for that was the original Virgo, the season of hunting by Sagittary, and in the same manner the rainy period of the deep winter by this figure of an human form, pouring water out of an urn.

It is thus we are to explain this, and thus we are to understand all the other constellations, but in this light we make a farther discovery. Aquarius denotes the bad weather, and the rain of the midwinter; but Egypt knows no rain; nor is there any season there better, or finer, than the winter. Therefore although the Greeks borrowed the knowledge of the constellations from the Egyptians, they also had them from some other people, or else they brought them from some other place with them; the last is the most probable. The use of the observations of the heavens is so great, that probably it began very early, and the Egyptians, when they took possession of the country about the Nile, brought with them thus much of astronomy from some other country, where all mankind after the deluge had lived together.

The antients, as they gave one of the twelve months of the year to the care and protection of each of the twelve principal deities, so they also gave to each of them the protection of some one of the signs of the zodiac. The constellation Aquarius was given to Diana, and from this circumstance it is that we meet with the accounts in the writings of the astrologers, which give the influence of sovereignty and chastity to Aquarius.

The poets have frequently referred to the name of this constellation as presiding over rains and winter; or, according to their language, and would it could not be said, also, in some degree, according to their philosophy, as the cause of the cold and wet of those seasons. We may laugh at this; but certainly absurd as the opinion was, it was not more contemptible than that of some later philosophers, who, as the day was allowed to be produced by the sun, the cause of light, attributed the night to certain stars which they supposed the cause of darkness, or, as some of their writers have worthily expressed it, tenebriferous luminaries. 'Tis certain that the opinion of rains, being occasioned by certain stars, had obtained in Arabia to a degree of worshipping those luminaries; and we find Mahomet in his alcoran expresly forbidding his followers from saying, that the rains, which occasioned the springing of the verdure, came from any particular *nou*, or star. Virgil talks of Aquarius in this sense;

Cum frigidus olim
Jam cadit extremoque irrorat Aquarius anno.

And Horace names the same constellation as bringing on the winter:

Quæ simul inversum contristat Aquarius annum.

These people were apt to speak figuratively, and it may be allowed to them: but there have been a set of readers who have chosen to understand all literally; and from errors and follies, as egregious as these, has arisen half the jargon of astrologers.

The astronomers of all nations have preserved the figure of a man pouring water out of an urn to express this constellation, excepting only the Arabians, their law did not allow them to draw an human figure on any occasion, so they have, in the stead of that, in this sign, placed a mule saddled and carrying two barrels of water.

AQUILA,

AQUILA, *the Eagle*. One of the conſtellations of the northern hemiſphere. We find it mentioned by all the aſtronomers, whoſe works have came down to us, and by all under the ſame form, and in the ſame ſituation in the heavens. It is one of the old forty-eight conſtellations, according to the diviſion of which, Hipparchus made his catalogue of the fixed ſtars, and which are deſcribed to us by Ptolemy. Some of the old writers call it a vulture, but the difference is not great. The figures however which we ſee in ſchemes of the heavens, always repreſent it, not as a vulture, but an eagle.

It is but a ſmall conſtellation in compariſon of many that are near it, though thoſe immediately about it are not much larger, and one of them the Sagitta or Arrow, much ſmaller. In proportion to the ſpace which it occupies in the heavens it comprehends a conſiderable quantity of ſtars, and ſome of them of magnitude, to make them very conſpicuous, ſo that upon the whole it is as conſpicuous a figure as any in the hemiſphere, and its place as early found.

The figure in which we ſee it repreſented exhibits it on the wing, but falling. It is ſuppoſed to have been tranſpierced by the arrow that is near it, and to have made ſo much of its way downward, as it is out of a line with that conſtellation. The body is large, the wing extended, and the tail in ſome degree ſpread.

The conſtellations which are placed immediately about the Eagle are the Dolphin, the Fox and Gooſe, and the Arrow. Theſe are all very near it. The Dolphin is placed in the front of it, and the figure extends from the tip of the wing to the head, but at ſome little diſtance. The head of the Dolphin is towards the wing of the Eagle, its tail overagainſt the head of that bird. The Fox and Gooſe are over the Eagle's courſe, and the Arrow between the fore legs of the Fox, and the wing of the Eagle, already mentioned. At a diſtance in the way towards which it ſeems directing its courſe, are Aquarius and Capricorn. The tail of the Serpent approaches towards the wing, and Hercules is at a diſtance behind it.

The antients counted fifteen ſtars in the ſign Aquila, but then the conſtellation Antinous, which has been of later time formed out of the ſtars near the Eagle, was not known, and they counted thoſe unformed ſtars, out of which Antinous has been made, into thoſe of the Eagle. When we ſpeak of the number allowed to the conſtellation Aquila by the late aſtronomers, we are to be underſtood as treating of thoſe in the figure of the Eagle alone, for the unformed ſtars which the antients uſed to account to it, we bring in under the Antinous. Tycho ſpeaking of the Eagle in this diſtinct light, allows it only twelve ſtars. Hevelius adds to the number conſiderably, he makes them twenty-three; and our Flamſtead, whoſe accuracy and diſcernment has outdone them all, makes them no fewer than ſeventy-one in the two conſtellations, for he alſo counts them together.

Of theſe there is one a lucid and glorious one of the firſt magnitude; it is near the inſertion of the neck, and is diſtinguiſhed by aſtronomers under the peculiar name of Lucida Aquilæ, and by ſome is called ſimply Aquila, it having been a cuſtom with many to call a conſtellation, and ſome other particular ſtar in it, by the ſame name. This is the caſe in Lyra and ſome others. There have been ſome for denying this bright ſtar a place in the firſt claſs, they have reduced it to the ſecond; but theſe diſtinctions are ſo arbitrary that it were idle to enter into the conſideration. Certainly the Lucida Aquilæ is not ſo large as Sirius, but as certainly there is no other ſtar allowed to

be

be of the ſecond magnitude, that is equal to it. There are indeed among the ſeveral claſſes into which men have, for convenience, arranged the ſtars not two exactly alike in any one aſſortment. There is not one ſtar of the ſecond magnitude in this conſtellation, but there are ſome of the third, and they make a conſpicuous appearance. The reſt are of the inferior orders in point of ſize, but not in general of the ſmalleſt. They are diſpoſed pretty regularly over the whole figure, but the body has fewer of them than the wings, and ſmaller. There are ſeveral of the third magnitude in each wing, and ſome in the neck near to the head. The head itſelf and the tail have many ſmall ones. Toward the right of the tail, and near the inſertion, there is a cluſter.

The Greeks, according to their cuſtom, have deviſed a great many accounts of the origin of this conſtellation. 'Tis this diverſity of ſtories that expoſes all to ſuſpicion. Had the thing been their own, they would have known its origin, and one account would have been ſufficient. 'Tis undoubted that they received the figure of this conſtellation with the reſt from their inſtructors the Egyptians. Probably Thales brought it to them; but, eager to be believed the founders of the ſcience, they would make it their own, by adapting a part of their hiſtory to it.

Some ſay it is the Eagle which their Jupiter commiſſioned to run away with Ganymede from mount Ida. Jupiter, they ſay, repaid the ſervice by placing it in the heavens. Others ſay, the Eagle was Ganymede himſelf at length converted into that form, and placed in the ſphere. But many give it another origin; they tell us of one Merops, a king of Coos, who married one of the retinue of Diana; they tell us, that the goddeſs ſhot the nymph with one of her arrows; that which, as they ſay, is ſtill preſerved in the heavens, and that Juno, after a ſeries of miſery, transformed Merops into an Eagle, and at length placed him there. Others ſay, that when Jupiter, in the form of the Swan, debauched Leda, he obtained the favour of Venus to purſue him in the ſhape of an Eagle. 'Twas in this pretended diſtreſs, they ſay, that he found the protection of that lady, and that he repaid the benefit by placing the Eagle of Venus as well as his own Swan in the ſkies.

But all theſe diſagree with the accounts which the ſame writers gave of the neighbouring conſtellation, the Arrow; for they ſay, that was the ſtar with which Hercules transfixed the Eagle, or the Vulture, for they called it indiſcriminately by either name, which fed upon the liver of Prometheus. If that be the caſe, this Eagle is the bird there ſpoken of, for they ſay 'tis fixed in the ſkies juſt below the Arrow, we are therefore to underſtand that this was the bird which Vulcan made by his art, and which Jove gave life unto, that it might execute his vengeance upon the chained Prometheus, who had been guilty of ſo many inſolencies toward his divinity. *See the article* SAGITTA.

ARA, *the Altar*. One of the old forty-eight conſtellations mentioned by all aſtronomers, and ſituated in the ſouthern hemiſphere. It is a figure in the heavens of very ſmall extent, and it comprehends only a ſmall number of ſtars. Theſe however are ſome of them large enough to be diſtinguiſhable beyond thoſe about them, and they are placed alſo in ſo ſmall a compaſs, that although a great deal is not to be ſaid in favour of their conforming themſelves to the lines of the figure, they are yet in the whole congeries very conſpicuous, and the conſtellation is very eaſily diſtinguiſhed.

It is represented in the ſchemes of the heavens by the figure of an altar, of plain ſtructure, broad at the bottom, and narrow at the top, and a body of fire and ſmoke is figured as riſing from its top, which is more than equal to the whole altar in extent, and contains likewiſe the greater part of the ſtars that are accounted to the conſtellation.

The other figures among, and between which the altar is placed, are the Bird of Paradiſe, the Peacock, the Southern Crown, the Scorpion, the Wolf and Centaur, and the Southern Triangle. The beak of the Bird of Paradiſe comes very near the top of the ſmoke, the tail of the Peacock alſo comes very near the ſmoke, the Southern Crown is at a diſtance from its foot, and the lower part of the Scorpion's tail is alſo very near one part of the foot, the Wolf and Centaur are at a diſtance above, and the Southern Triangle comes very near the top of the ſmoke. The old aſtronomers counted only ſeven ſtars to the conſtellation Ara, but Flamſtead has added two to the number, and made them nine. Not one of theſe is of the firſt, ſecond, or third magnitude, but there are five of the fourth, and two of the fifth. Theſe are the ſeven old ſtars allowed to the conſtellation, the two added by Flamſtead are ſmaller; the greater part of theſe are in the ſmoke; there are only three on the body of the altar, and one of theſe is not very conſpicuous.

When we conſider that the worſhip of the hoſt of heaven was as early almoſt as aſtronomy, and that a degree of piety was always mixed with the antient obſervations of the ſtars, we ſhall not wonder that an altar was a figure very early added to the conſtellations. It is doubtleſs of Egyptian origin, as indeed are almoſt all the others; but the Greeks, who are not willing to have the origin of that ſcience, which they taught the reſt of the world, carried out of their own country, will have it to relate to ſome part of their hiſtory. This is their univerſal cuſtom with reſpect to the whole forty-eight, every one of which has ſome part of their fable annexed to it. They tell us, that this is the altar on which the gods themſelves ſwore, and bound themſelves to one another, when they entered into a league againſt the Titans; they ſay, it was the work of the Cyclops. This they give as the origin of all ſolemn engagements, and ſay, that men, having been informed of this act among the gods, when they had any ſolemn league to make with one another, always began it by ſacrifice.

ARANEA. A conſtellation offered to the aſtronomical world, and compoſed of a cluſter of unformed and very conſpicuous ſtars near the ſign Virgo.

The creature, under the out-lines of whoſe figure they are comprehended, is the common long-legged ſpider, which we ſee in fields among the graſs in ſummer, and which the old writers on natural hiſtory have all deſcribed under the name of the field ſpider, and the late ones under that of the long-legged ſpider, or Acarus.

It is a little conſtellation, but for the ſpace it occupies is not ill provided of ſtars, and they are very happily diſpoſed to anſwer to the principal parts of the figure; it is repreſented in a poſture of walking, raiſed from the ground by its long legs, and marching from the conſtellation Virgo toward the lower part of that of Hydra.

The only conſtellation, beſide theſe, which is near to it, is the Raven on the back of the Hydra, and at ſome diſtance are the ſcales of the ſign Libra. It occupies a ſpace between theſe, but does not fill it up, or become at all confounded with them, although it takes in all

all the ſtars that are left unformed by thoſe; theſe ſtars luckily ſtand in a cluſter together about the middle of the ſpace, and are all placed in ſome particular part of the figure of this inſect. The hinder part of the ſpider is very near to the knee of Virgo, and to the ſpike or ear of corn in the left hand: its head is directed toward that part of the body of the Hydra a little below where the raven ſits, but at ſome diſtance; the tail of the raven is nearly at an equal diſtance from the left legs of the ſpider, its right legs are near a part of the robe of Virgo, and are turned toward the ſign of Libra; but this is at a conſiderable diſtance.

The conſpicuous ſtars in the conſtellation Aranea are thirteen, and they are far the greater part of ſuch magnitudes as to make a very bright appearance. There is one placed juſt at the meeting of the forceps before the head, and one ſtar at the extremity of the body, or at the rump of the creature. The reſt are diſpoſed about the legs and feet. With reſpect to the four legs on the right ſide, there is one ſtar at the extremity or foot of each; and on the third there is alſo another ſtar about the joint of the knee. With reſpect to the four on the left ſide, the firſt leg has two ſtars almoſt cloſe together at the extremity or foot; the ſecond has one at the upper joint, and one at the foot; the third has none at the foot, but one at the middle joint; and the fourth has one at the foot, and none in any other part. Theſe are all remote enough from the neareſt of thoſe of any other conſtellation, and there is no confuſion.

ARC *of a Circle*. A part of the circumference of a circle of whatever magnitude. *See* CIRCLE.

ARC *diurnal of the Sun*. When from the place of obſervation the ſun's apparent diurnal motion is performed in a circle, one part of which is above the horizon, and another part of it is below the horizon, that part of this circle which is above the horizon, is what aſtronomers call the ſun's diurnal arc; and, on the contrary, that part of the ſame circle which is below the horizon, is called the ſun's nocturnal arc.

ARC *nocturnal*. That part of the circle which the ſun deſcribes in his motion round the earth, and in his diurnal courſe, which is below the horizon of the place of obſervation. On the difference of theſe depends the difference of length of day and night: and to the equality of the diurnal and nocturnal arcs under the line, it is owing that there is there a perpetual equinox; that is, the days and nights are equal throughout the whole year, every day being twelve hours, and every night twelve hours.

ARCAS. A name by which ſome of the old writers call the ſtar Arcturus; a ſingle and very bright ſtar of the firſt magnitude, between the legs of the conſtellation Bootes. This was the name of the youth, the ſon of Calliſto, whom, they ſay, Jupiter raiſed into heaven. *See* ARCTURUS.

ARCHER. One of the conſtellations of the northern hemiſphere, and of the twelve ſigns of the zodiac. It is placed between the Scorpion and Capricorn. *See* SAGITTARIUS.

ARCTIC CIRCLE. We find the antient aſtronomers frequently uſing this term in ſpeaking of the viſible hemiſphere. They mean by it the largeſt parallel that is ſeen entire above the horizon of any place in north latitude; this they call the Arctic Circle of that place. And in the compaſs of this circle,

or

or in the extent between the circumference and the north pole, are arranged thoſe ſtars which are always above the horizon in that place, and make their revolution above the horizon in circles parallel to the equator; theſe, whenever it was dark enough, were to be ſeen in ſome part or other of the compaſs of that circle.

ARCTIC POLE. The north pole. *See the article* POLES *of the world, and* CIRCLES *of the ſphere.*

ARCTOPHYLAX. A name by which ſome of the old writers have called the ſtar Arcturus. A ſingle fixed ſtar of the firſt magnitude thus named, ſituated between the thighs of Bootes, near to the left knee of that conſtellation. They ſay Arcas, the ſon of Calliſto, by Jupiter, when he was about to have killed his mother in the ſhape of a bear, was, together with her, ſnatched up into heaven, and ſhe converted into the Great Bear near the north pole; and the youth into this ſingle ſtar.

ARCTURUS. A name given by the Greeks to a ſtar of the firſt magnitude in the northern hemiſphere toward the pole; it is placed at ſome diſtance from the Great Bear, and is between the thighs of Bootes. The Greeks regarded this ſingle ſtar as a conſtellation, they honoured it with this peculiar name, and gave an hiſtory of its origin, as they did of thoſe of the other conſtellations.

Calliſto, who was afterwards, in form of the Great Bear, raiſed up into a conſtellation, they tell us, brought forth a ſon to Jupiter, whom they called Arcas. They ſay, that Lyacon, when Jupiter afterwards came to viſit him, cut the boy to pieces, and ſerved him up at the table. Jupiter, in revenge, as well as by way of puniſhment, they add, called down lightning to conſume the palace, and turned the monarch into a wolf. The limbs of the boy were gathered up, they ſay, and the god gave them life again, and he was educated by ſome of the people. His mother, who was all this time a bear in the woods, fell in his way; he chaced her, ignorant of the fact, and ſhe threw herſelf, to avoid him, into the temple of Jupiter: he followed her thither to deſtroy her, and this being death by the laws of the country, they ſay, Jupiter took them both up into heaven to prevent the puniſhment, making her the Great Bear among the conſtellations, and converting the youth into this ſingle ſtar behind her.

The ſtars particulariſed in the ſcriptures are ſo few, that it were unpardonable not to inform ourſelves concerning them as far as at this diſtance of time that may be done. Arcturus is one of theſe, at leaſt the Engliſh verſion, and many of the other tranſlations, give it ſo: but we have cauſe to doubt whether the verſion agrees as perfectly as it ought ſo to do with the original, were it only for this, that Arcturus is not ſo conſiderable a ſtar in point of its uſe as many that might have been ſelected; nor indeed does it appear that the ſacred writers, when they look up to the heavens for inſtances of the power and goodneſs of God, ſelected, at any time, a ſingle ſtar to expreſs that power, or one of no immediate uſe to mankind, to give an example of that goodneſs. The heavens were, at the time when thoſe books, in which this word occurs, were written, divided into conſtellations, and a reſpect was paid to their forms. The naming one of theſe conſtellations was a thing of more dignity than the naming a ſingle ſtar; and ſome of theſe were the directors of the huſbandmen, and others of them the guides to ſailors: theſe were of uſe, and all were of ſhew and ſplendor; it is therefore much more probable, that

a con-

a constellation should be named on any occasion of this kind than a single star; and among those it was most likely that such should be mentioned, as men had already set up to themselves for signs and marks of the seasons, or points by which to direct their course when they had no other marks that could serve them for that purpose; whether this were in voyaging out of sight of shore, or in travelling over the vast deserts which they passed, and in the whole space of which there was no land-mark of any kind: for we find, by the earliest historians, that they used the constellations, especially those toward the north pole, on these occasions.

That an eastern writer, when he had a desire to express the greatness and power of the deity, should look up to the heavens, and call in to his assistance the vast form of some constellation, consisting of a multitude of stars; or, that when he was eager to display his goodness together with his power, he should appeal to such of these as mark the several seasons of the year, or points of the heavens; is very natural: since the use of such was as conspicuous as the amazing structure of the others. But why, when he had the whole furniture of the skies at his command, he should fix upon a single star, none can say, nor indeed is it to be supposed that any would do so. If it be urged that Arcturus is a large and bright star, and therefore conspicuous, the reason will not be allowed at all conclusive. Arcturus is a star of the first magnitude, but there are many more such in the hemisphere; and it is not the most considerable of these, since Sirius, and that in Lyra, with several others that might be named, exceed Arcturus in this particular: beside, that these being already received into constellations (for the greater part of these large stars were very early received into some or other) the writer would have had an opportunity of naming any of them with the rest in the mention of such a constellation.

It will appear from these observations, and it will be verified by the examination, that, when the inspired writers looked up to the heavens for testimony of the power and other attributes of God, they did not refer themselves to any single star, for that would have been idle, nor to the constellations at random, for that would have been vague and undeterminate; but they always selected some particular constellation or constellations, for they usually named two or three together; always assemblages of stars, not single ones: and among the number of those which were before them, they did not take one or another at random, but always selected such as were particularised by the people, among whom they wrote, and served them for useful purposes. This we shall find by examining the several parts of scripture, in which there is any mention of constellations, or of any thing relating to the heavens: and as this is universally the case, we shall have reason to believe that this particular word, which the translators have rendered by Arcturus, did, in reality, as well as the rest, mean a constellation, or an assemblage of stars, and not a single star.

In order to know what things are, it is first necessary to discover what they are not; if we take the name Arcturus, upon credit, to be a proper version of the word *Aish*, for that is the term which stands in this place in the Hebrew bible, we shall have no business to enquire farther; but if we find reason to question the authority of this version, we may then begin to seek after a better, and to determine what was the constellation intended by the sacred writers in that place, where they have used the word that is rendered by Arcturus.

It

It is natural to suppose, that astronomy, so far as it concerned the fixed stars, was a very early science. People who lived in an open country, who had the concerns of husbandry to mind, and who had as yet no regular division of the year, naturally looked up to the heavens. They saw certain stars return at certain periods, and they perceived that the fruits of the earth, and the breeding of their cattle, followed regularly these appearances: they marked them therefore as notices of what was about to follow, and they soon after began to consider the rising of certain others as indications of approaching, though not immediately approaching seasons. There was a time for sowing, that their harvest might be ready under a certain other series of stars, which marked the proper period for the cutting of it. They had no other way of knowing this seeds-time but by the risings of these stars, and they therefore took account of them as much as of the others.

In order to implant these things in their memory, they had not recourse to any single star on either occasion; for as there are more than one of any determinate bigness or appearance, they might be misled by that; but they chose to remark a certain number together, ten, twenty, thirty, or more, which stood in a certain relation to one another, that was not to be found in any other series. Any cluster of stars were by this means to be distinguished from any other cluster in the heavens with perfect precision, and beyond a possibility of error, although no single star could be so well distinguished. It was this that naturally gave origin to the constellations.

There were quantities of stars, that, rising together, denoted the season of certain events in husbandry; and how could they so well be remembered, as by giving to them some figure corresponding, or, in some degree, corresponding to the thing they represented, or which they might, by the help of a little fancy, be supposed to represent in the heavens. Thus one parcel of these stars was supposed to represent the form of a giant, another cluster that of a serpent, and so of the rest. When these arose they knew what was proper to be done in the field or vineyard. This we find by their expressions on the occasion. When Virgil would say that he is about to tell the seasons at which the several articles of husbandry are to be set about, he does not use the name of any time of the year, but says under what star:

Quo sydere terram
Vertere, et ulmis adjungere vites.

And we find him, in the same manner also afterwards talking of the Lucidus Anguis, that is, the constellation Draco, and of some others.

When the husbandmen had marked the necessary seasons of their labours by certain stars, which they had represented to themselves, as belonging to certain parts of the figures of peculiar animals, or other forms, the marks of fancy or whim, the travellers began to find that an observation of the heavens might be also of vast use to them. Not only those who first ventured out of sight of land in their little barks, but those who travelled by land over the vast desarts in which all was as vacant of marks, or any other means of direction for their course, as on the sea itself. These began to look up to the heavens for what they could not find elsewhere, and among the several stars which offered in the bright nights to their observation, they found some, which, being near the pole, did not change their places like the others, and were therefore proper for their marks of guidance. This was very natural,

and

and must have been, as we are told it was, very antient. Diodorus Siculus, and others of the early historians, mention this observation of the stars about the pole, by those who pursued their travels over the desarts of Arabia, and it is possible that it may have been earlier than the observation of the same stars at sea, and may indeed have given origin to it. Indeed, without a previous knowledge that there were such stars which would so assist them, it is scarce to be conceived that any people could dare to venture out to sea, or if they did venture out, that they could possibly get back again.

Thus we find the origin of certain constellations very naturally explained; and so that it was indeed in a manner impossible men could have been long without forming them. But these would be only a few, three or four for the husbandman, and one or two for the travellers would be sufficient. The arrangement of all the stars in the heavens into constellations, might very naturally follow this, when men had leisure and curiosity: but although this first formation of the few constellations that were necessary for the affairs of life, had led the way to it, many ages might easily pass before the work of curiosity was accomplished; many possibly before it was set about.

Experience testifies what it was thus natural to suppose should be the case with respect to the constellations of the early ages; four or five it was natural to imagine would be thus formed long before any others were thought of, and accordingly we do find that four or five constellations are named among the very early writers of all nations, and we find none added to them for a great many ages. In the earliest written books of the scriptures, we find no mention of any constellations, nor indeed was it to be imagined that we should, for many who are for carrying the origin of astronomy very high, do not yet pretend to make it so early as the days of Moses: but in the later books, as the prophecies of Isaiah and Amos, and in the book of Job, which, for that reason only, were there no others, might be concluded not to be written by Moses, as some have very idly pretended; there is mention of some. These are, as it was natural they should be in so early a period, only four or five, and they are the same in all these writers. When Amos appeals to the heavens, as testifying the glory and power of God, he mentions three or four constellations. When the author, whosoever that was, of the book of Job, is warm in expressing the power and goodness of God, he also mentions about the same number; and when Isaiah denounces the vengeance of the Almighty, he threatens darkning the constellations, as one of the articles of that punishment men were to suffer, and he also confines himself within the same number. They all mention these few, and only these few, and they all express them by the same names. These are Chimah, Chesil, Aish, Nabash-Barih, and Mazaroth and Mazaloth.

In the same manner we find the old Greeks, when they have occasion to speak of the constellations, mention only very few. Four or five is also their number, and in the writings of whatsoever authors they occur, the names are, as among the Hebrews, always the same. Orion, the Pleiades, and Arcturus, are three which we find named in the most antient of their writings, and after these the Hyades and Syrius; and in the succeeding time the others. The constellations were invented by the Egyptians, Babylonians, and Chaldeans, and by them taught to the

Greeks;

Greeks; the learned men of the latter nation, for many centuries before the Christian æra, making it a part of their education to travel to Egypt. As the Egyptians did not invent all the constellations at a time, so neither did the Greeks name them all at a time. They were placed one after another, as curiosity enlarged itself in the maps of the heavens among the Egyptians; and they were afterward brought successively, and not all together, into Greece, and added one after another to the sphere of that country; for that the Grecian sphere was not compleated at once, is a matter of abundant testimony.

Having thus far looked into the origin of astronomy, which cannot be thought foreign to a work of this kind, and which (as a general knowledge of the whole is requisite to the perfectly understanding of any part) was even necessary to the explaining this single constellation, of which we treat under the name of Arcturus; it may be time to enquire into the motives of the translators of the Bible, for giving the names of certain Greek constellations, as a version of certain words which they very properly judged to be names of constellations in the Hebrew. It is certain, that they did this at random, and that they have committed great errors in it; and the agreeing to this is a first step to our coming at the truth.

It has been already observed, that the Hebrew books mention only four or five constellations, and these they have under names, which there is no reason to suppose the translators understood: for we cannot, with any degree of probability, suppose those translators, be they who they would, to have been at all acquainted with the Chaldæan, or old astronomy, to which they belonged. In this case let us consider, what it was most likely they would do, and we shall find they have done it.

What would have been proper for them to do is plain: when they did not understand the term in the original, they should have continued it in the translation; and not have attempted to give its meaning: but this, though done in some passages of the scriptures, is not practised in these. We shall find them determined to translate what they found to be the names of four or five constellations, and which they did not know how to appropriate to any in particular. What were they then to do? They found these were only a small number, and they found a small and an equal number mentioned by the early Greeks; and guessing, not without some degree of reason, that these four or five of the Greeks, being the earliest of the constellations, were the same with those of the Hebrew, they determined to give their names for the translation of these words. When this was done, it yet remained to ascertain which of the Greek names belonged to which of the Hebrew; and this it was plain was to be done at random.

It has happened, that the first conjecture was in some degree true, and that a part of the few old Greek constellations were the same with these of the Hebrew writers, but not all. Orion and the Pleiades are indeed two of the Hebrew constellations, but Arcturus has no place among them. And as to those two, it has so happened that neither of them have been referred to that Hebrew name to which they belonged.

The Greek version of the Bible has every where translated Chimah by the Pleiades; but Chimah properly signifies a giant, and is the name of Orion. They translated the word Chesel by Orion, and that is the real name of Ursa Major, the Great Bear, and when used, as it is by Isaiah, in the plural number, Chesilim, signifies the two Bears, or the constellations Ursa Major and Ursa Minor. Aish

is

is the word they have rendered by Arcturus, but this is the proper name of the Pleiades, as will be proved in the succeeding part of this article. And the Nabash Barih, the plain English of which is the crooked serpent, they do not seem to have understood as the name of a constellation, but of the creature itself: but however it is plain, that it means the constellation Draco.

Before we proceed to the reasons for declaring Aish not to mean the star Arcturus, as it is translated, but the constellation Pleiades, which is the immediate business of this enquiry, it may be necessary to explain the reasons for supposing the translators of the Bible, not acquainted with the science, by means of which alone they could have been enabled to render these words properly. That they have not done so, is evident from the passages themselves; and that they could not, will appear as plain from an enquiry into who they were that made the translation. Men might be capable of doing perfect justice to every other part of a work like the bible, and yet, in this singular circumstance, they might be quite deficient: and this will be found to have been exactly the case.

We are first of all then to enquire, who they were that made the translations of those books of the Old Testament, in which these constellations are mentioned. That they were the body of learned men, understood by the name of the Septuagint translators, is not to be ascertained, since there is some reason to believe those men did not translate the whole Old Testament, but only a part: perhaps only the books of Moses. If these did not, it is hard to say who it was that did translate these books: and this is to be observed, with regard to the probability of their not having translated them, that the book of Job, which is one of the three in which the constellations are named, is very ill translated in many places: in some the sense of the author is quite mistaken, and in others it is very imperfectly expressed. If the translators of these books were not the learned persons employed by Ptolemy to give a version of the law, they appear to have been much inferior to them in abilities, and consequently less to be depended on: but as this cannot be proved, for negatives are not easily proved, especially in cases so obscure, let us suppose that they were these persons who made the translation, and we shall still find there is reason enough to conclude they were ignorant of the meaning of these words. They might be very well versed in the languages, but quite ignorant of the science of astronomy, by which alone they would have been enabled to understand those terms. The Jews never were allowed a wise people, the sciences never were regarded among them; and of all others astronomy was the least likely to be regarded, and was that of which we find the least probability of their ever having taken any notice. It would have been dangerous indeed for any one among them to have attempted it: for the worship of the host of heaven having been always named to them among the most heinous idolatries, they would not have distinguished between studying their motions, and adoring them as divinities. In their most prosperous times we find no account of their having applied themselves to any of the sciences whatever, and in their distresses it is not to be supposed they would: when they were slaves, and that to masters, whose affairs were themselves fluctuating, and whose government often in danger, we cannot suppose they applied themselves to such studies; and afterwards we see all their attemps in learning were confined to a credulous study of their own language, which had been in part lost, and in the old phrases, of which it

it was their sole employment to find or fancy mystical meanings.

In the best of these situations we shall not find the Jews likely to understand any great matter of astronomy: if there was a time when they can be conceived to have known any thing at all of it, it is most probably that of their captivity, when they were among a people who studied it. At this time they might have heard the names of a few of the principal constellations, but after this, there is no doubt of their forgeting them again, as when gathered to themselves again, they would neglect the learning and knowledge of their conquerors; and retain no trace of things, which had never been studied among their people.

We shall find by this that even the Septuagint translators, whom Ptolemy engaged to make a version of the whole, or of some part at least of the Old Testament into Greek, were not likely to know any thing of the terms of a science, not at all cultivated among them; and that, supposing them to have been the translators of the books of Job and Isaiah, and Amos, still we should have no reason to abide by their decisions, as to what was meant by the names of certain constellations mentioned in those books.

That the translators of those books, whether they were these or others, were quite uninformed of the nature of these constellations, and the meaning of the terms by which they were expressed, is obvious, in that they have not rendered the term Nabash Barih, by any name of a constellation at all: not having called it Draco, but translated the words as if spoken of the serpent, as a reptile upon the earth; though this could not be the intent of the author, as appears by the context, in which he names the heavens, whose spirit maketh the heavens, and whose hand hath formed the crooked serpent. Now it was not at all natural to suppose the same sentence meant to describe the vast power of the creator, should call in the heavens as a testimony of it, and add so inconsiderable a creature as the serpent of the earth; beside that, the epithet which exactly expresses tortuous, has nothing to do with the serpent of the earth; for although it can twist itself about, yet, as it does not always appear twisted, it would never have had such an epithet added to its name in general; whereas the constellation Draco is crooked, or exactly what we mean by tortuous, and its figure in the heavens could not be expressed by a more proper word. In the same manner, their translating Chimah, which signifies a giant, by the Pleiades, and calling Chesil Orion, although in other places it was in the plural number, and although in the very place in Job, where it is first named, there are, connected within it, words which signify bands and loosening, shew that they neither knew what was meant by the term they found in the Hebrew, nor gave themselves the trouble to examine; for certainly, if they had considered that this Chesil, as it was one of the few constellations first named, must be one of those which were of use to mankind; if they had considered that Isaiah makes the obscuring its light, an article of divine vengeance, they would have known that its use must be the most important; and if they had added to this the naming it by Isaiah in the plural number, as expressing two constellations of the same denomination; and, finally, the terms of loosing the bands or cords belonging to it, they must have been led to determine, that it was not Orion, as they have translated it, and to which it has no one article of allusion, but the Great Bear, or the two bears, for such it certainly is. These the old authors, even the old Greeks, did not call two bears, but two waggons;

gons; these are of such importance to a nation, that there was no voyaging or travelling without their assistance; and they, as they were represented to be drawn each by a team of horses, might very well justify the use of tying and loosing, and of cords or bands, without which they could not be fastened to the carriage. This was undoubtedly the meaning of the term, and the explanation of the words used in mentioning it; and it would have been much better to have attempted it thus, by way of finding out what was meant by the word, than to have endeavoured to explain the terms binding and loosing by the chimerical allusion to northern stars shutting up the earth, and fourthern stars opening it, and making way for fruits and flowers.

Instead of that method of commenting upon the accidents, it surely would have been more rational to have fallen upon the other, of explaining the term itself: and this is what, after this long but necessary introduction, I shall endeavour with respect to the word Aish; which the translators of the book of Job have rendered Arcturus, but which, I am convinced, means the Pleiades. Without thus much, by way of preface, many might have been unwilling to doubt the Septuagint translation, for so it is all called, of the bible; and, without instances of the palpable mistakes which those translators have made with regard to the other constellations that are named in the same books, it might have been with reluctance that many would have listened to the opinion of an error with respect to this.

In all things, to understand an author rightly, the first step is to observe the context, and in this particular we shall find that to be the road to a true explanation. We have seen, that, by considering the words used with, and applied to, the constellation Chesil, mentioned in Job and Isaiah, it appeared not only that it was not that which is given as the translation of the word, but we found what it certainly is, that it is not Orion but Ursa. In the same manner let us consider the words, where Aish, rendered Arcturus, is mentioned, and we shall find not only that it is not Arcturus, but that it is the Pleiades.

Chimah and Chesil are mentioned several times, but this Aish only once, in the scriptures. The passage is in the book of Job, and it is this: "Canst thou bind the sweet influence "of Chimah (that is of Orion) or loose the "bands of Chesil (that is Amaxa, the wain). "Canst thou bring out Mazzaroth in his season (that is, the several parts of that circle "which the antients called the circle of the "moon, or mansions of the moon) or lead "Aish, Arcturus, as they translate it (but truly "the Pleiades) with its sons?"

According to the plan of this investigation, we are to examine what is the meaning of the words its sons, for that will lead us to know to what constellation the term is applicable, and that the Pleiades, and no other, can be the proper rendering of the word *Aish*. That Arcturus has not, nor can have, any thing that can be expressed by the term his sons, or his children, is obvious; all that the commentators have attempted, by way of accounting for the expression, is to say, that it meant the stars about Arcturus; but this might as well be said of any other constellation, since there are stars about all the other constellations; and therefore a writer, equal to the language and sublimity of the book of Job, would not have mentioned such a thing with no better meaning. That there is nothing particular with regard to Arcturus which should make any other stars be called its children, is certain: let us examine whether there be any other constellation that may have a right to have other stars called by this name, and if we find such a one, there will be great reason to believe that it is this, and

not

not Arcturus, which was intended by the word Aish in the original.

We know the figurative manner of expression that was universal throughout the east; and, according to this, we shall find that any number of stars, understood to be attendants on any constellation, or followers of its motions, might be very naturally called its family, its children, or its sons. Now we shall see, that not only a particular number of stars about the constellation Aish, as those imagined who rendered it Arcturus, though without any particular reason for such an imagination, were called its sons; but that all the host of heaven, the whole train of the fixed stars, are, with great propriety and strictness, according to the old philosophy, to be called the children of the Pleiades; and this is much more suitable to the dignity of the writer of the book of Job, than it would have been to mention a few particular stars, and that with no peculiar reason.

Though we can find no reason why any stars should be called by the name of the attendants on Arcturus, we shall find that all the stars might be, nay, and naturally, were called attendants on the Pleiades, if we consider of what importance the Pleiades were in the old sphere, and in the antient philosophy: and surely the thought and the expression are both great and suited to the subject, when the Almighty, enumerating his works, and the conduct, œconomy, and regulation of them, speaks of such a constellation as was supposed to lead in the whole multitude of the stars, and calls that act the directing, guiding, or leading in that and all its sons.

The antients divided the course of their year according to the appearance of the several constellations, and the Pleiades were the first of these. This account we shall find in the earliest Greek writers, and they had their astronomy from the east, therefore it was the system there also that the Pleiades led in the year. They were the new year's constellations, and all the others were supposed to follow them; these were therefore called attendants on the Pleiades, and the year, from the name of this constellation, was called Pleion. Into whatsoever author of antiquity we look, we shall find these stars, or the constellation in which they stand, which is that of Taurus, mentioned as that which began the year, and nothing can be so applicable to it, as calling the other stars its offspring or attendants: nor can this be applicable to any other constellation whatsoever. This might be enough to fix the certainty of the Pleiades, and not Arcturus, being the Aish of the scriptures; but even if we look into the better sort of the commentators on the passage, in which Aish is named, we shall find that they do not all agree to its meaning Arcturus: nay, we shall find that some of them had met with explanations of the true sense of the word, though they seem to have confused themselves by misunderstanding those expositions. Some of them, according to the Syrian exposition, suppose it to mean the constellation Orion, and others the three principal stars in the head of that constellation: these last suppose that all the rest of the stars, which go to form that constellation, are intended to be expressed by the name of the sons of these. Some have supposed the star of the first magnitude in the Great Dog, the Syrius, a star very early particularised, and well known to all the antient astronomers to have been intended by it; and they will have the rest of the stars, in that constellation, as little ones attending the large one, to be meant by the term sons. Others have supposed the sign Pisces to have been meant by it; this seems to have arisen from the word Ash, signifying, in the Ethiopic language, a fish. But that is not a constellation old enough in the sphere, nor of consequence enough to mankind to have

been

been honoured with ſo particular a notice; nor is there any particular meaning in the words, its ſons, or its attendants, if applied to this conſtellation. Let it not ſeem ſtrange, that one of the ſigns of the zodiac, for ſuch is the conſtellation Piſces, is mentioned as not being one of the oldeſt in the ſphere. We know that thoſe twelve ſigns are very antient, but we have all the reaſon in the world to believe that there are others much more ſo. If we look into the aſtronomy of the Greeks we ſhall find a few, and only a few arrangements of the ſtars known at the firſt, and theſe ſuch as were of immediate uſe: the diviſion of the year was, in compariſon of theſe, a matter of curioſity; and conſequently the zodiac was later received among them. In the ſame order as they were brought into uſe among the Greeks, we have reaſon to ſuppoſe they were deviſed among the Egyptians, and thus neither among the one nor the other people, nor indeed in any country whatſoever, can we imagine a conſtellation ſo little conſpicuous in the heavens as Piſces, (for very few are leſs ſo) and withal of ſo little immediate uſe in the affairs of life, was ſo early known as thoſe which marked the opening of the year, or denoted the time of the ploughing the ground, of ſowing the corn, or of reaping the harveſt; or, as thoſe, which, being fixed about the poll, were the guides and directors to mariners, and thoſe who travelled over deſarts. The Egyptians, or the foreſathers of the Egyptians, before they came into that country, might deviſe the conſtellations of the zodiac; but theſe not perfectly agreeing with the ſeaſons of Egypt, (for they certainly do not, the harveſt ſign of Virgo, with the ear of corn, being in the autumn, and their harveſt in April) might be neglected though known; and the Sirius, whoſe riſing marked the ſwelling of the Nile, on which all their encreaſe depended, regarded even with veneration. In the ſame manner the Bear, by which ſailors and travellers guided their courſe, the Pleiades, which marked the opening of the year, and ſome others of ſuch importance, might be, and naturally would be, regarded by other nations, and appealed unto by writers, who were deſirous of pointing out the goodneſs as well as the magnificence of the Deity in his works; while ſuch a ſign as Piſces, although a part of the zodiac, might be neglected, if known, as improper to be mentioned to ſuch purpoſes, becauſe its uſe is not conſpicuous.

It has been already obſerved, that ſome of the old commentators, though without underſtanding what they had repeated, had ſomewhere picked up the terms of a real and proper explanation, and, from their miſrepreſentations of thoſe terms, ſome of the moderns have framed notions as remote from truth as the wildeſt of the others among the old ones. We find many of the late laborious and learned commentators explaining Aiſh, not by Arcturus, but by the Great Bear. This has much more appearance of probability than in the choice of Piſces, becauſe one was a conſtellation undoubtedly of very early origin, and of vaſt uſe and importance to the world; nay, and there ſeems alſo a way of accounting for the words, its ſons, and for the very original name of Aiſh, when applied to this conſtellation; though there could be none, nor any offer made toward either, with reſpect either to Arcturus or Piſces. This is one of thoſe errors, which, having the parade of learning for its foundation, and being ſupported by ſomething, at leaſt in ſound, agreeing with it in the old comments, are the moſt dangerous and likely to miſlead; it is thence the more neceſſary to enquire thoroughly into what has been alledged in its ſupport.

In the firſt place we are to underſtand, that although the Bear be the common term by which

which that conſtellation is known at preſent, and by which it was known among the Greeks of later ages, yet among the earlier it was called by other names. It will be ſhewn hereafter under the article Orion, by which name the tranſlators of theſe books of the bible have rendered the oriental name of the Great Bear Cheſil, that this conſtellation was called by the earlier Greeks (as already ſaid) Amaxa, a waggon: and it will be obſerved alſo, in the account of this conſtellation under its ordinary name Urſa Major, that the Arabians called it not a bear, nor even a waggon, but a bier, a machine for carrying the dead to their funerals: and that they called the three ſtars in the tail of the Great Bear the Filii Feretri, or children or ſons of the bier. This was a phraſe, harſh as it ſeems to us, not unuſual among the eaſtern nations when ſpeaking of things dependent on ſome other; and from this, many of the late commentators on the book of Job have been led to think the Urſa Major certainly the conſtellation intended, becauſe here was an eaſtern phraſe, anſwering exactly to the term ſons, belonging to this conſtellation. Though Arcturus and his ſons were nonſenſe, yet to guide the bier and its ſons, though a ſtrange expreſſion, yet, according to this account, was not nonſenſe, at leaſt not without ſomething in its ſupport. It has been added alſo by the lexicographers, perſons, who, conſidering only words, have a rational excuſe for knowing nothing of meanings, that there is an Arabic word which ſounds very like Aiſh, and which is a name of this very machine which the Arabians ſuppoſed figured out by the conſtellation that we call the Bear; for Náſh, they ſay, is Arabic for a bier, and they ſuppoſe the Aiſh, in the Hebrew text of the book of Job, might be derived from this word Náſh, and ſo be the proper name of this, and no other conſtellation.

Thoſe who are captivated with this etymology, though it is a very forced one, and think the Arabic phraſe of children of the bier, a full proof that it is right, have treated, with ſome ſeverity, the tranſlators, who rendered the word Aiſh by Arcturus: but they are as liable to cenſure; and the more, becauſe the others have barely given the word they thought belonged to the place, but theſe have ſupported their doctrine by imaginary authorities.

On tracing this error to its head, we ſhall find that it is derived from that early approach made by ſome of the Hebrew commentators toward the truth; and by their ignorant and erroneous interpretation of the terms, which, whereſoever they found them, might, with a little better managment, have informed them of the whole matter. We find in two or three of them this plain and free interpretation of the original term Aiſh, that it is the name by which the author of this book calls the *Seven Stars*. The Seven Stars is a known, and has been a very antient name for the Pleiades, and had the commentators reſted here, they had ſaved all the errors that have ariſen on this head. Aiſh is certainly the Seven Stars, that is the Pleiades, and there had needed no more explanation. We know that theſe ſtars opened the courſe of the year according to the old account of time, and all the reſt of the ſtars following them in their courſe, might very naturally be called their children. But theſe are a ſet of writers, who, not having the great ſecret of the painters, the *manum de tabula*, know not where to ſtop. The firſt of theſe, for, in all probability, the reſt copied it from one another, having tranſcribed what he found in ſome more knowing writer, muſt add his explanation of a thing, ſufficiently plain in itſelf; and in the true ſpirit of heavy comments, perplexes and puzzles that which was clear. One would think the term Seven Stars, which has gone thro' all languages as a name of this conſtella-

conſtellation, was not very likely to be miſunderſtood; but there were alſo ſome others characteriſed, as being ſeven, by ſome of the antients, and call the Septemtriones. Theſe do not belong to that part of the heavens where the Pleiades are, but to a part near the north pole, and to that conſtellation, called, as has been obſerved already, the Bear, the Wain or Waggon, and the Bier. Thoſe who write upon ſubjects which they do not underſtand, and this is the general fate of commentators, ſeldom miſs an error into which it is poſſible to fall. One would ſuppoſe the underſtanding the term Seven Stars to be any other than the Pleiades, was a blunder which it was barely poſſible to arrive at; but there was a poſſibility of it, and Aben Ezra, for he is the firſt that has delivered this doctrine, tells us, that the word Aiſh ſignifies the Seven Stars, that is, the Septemtriones, a conſtellation, otherwiſe called the Waggon, and the Great Bear, and ſituated near to the north pole.

Miſtakes never ſleep in the hands to which they owe their origin. Here was a pompous and glaring one, it has been preſerved and copied, and done into half the languages in the world; and from this has ariſen the general opinion, that what is called Arcturus in our tranſlations, ſhould have been rendered Arctos, and that this ſhould have been again tranſlated the Bear; and finally, that what is meant by Arcturus, and his ſons, is the Bear, and its tail.

The underſtanding one of the ſcripture conſtellations, leads us to the aſcertaining another. But if we would indeed take upon credit the tranſlation of any one of them, it might be in vain we ſought for another. There are only a few named; there are only a few that were conſpicuous, and conſiderable enough to be named at that early time; and one or other of theſe names muſt be ſuppoſed to agree with one or other of them. It will be hereafter ſhewn in its proper place, that the tranſlators of the book of Job, and of the prophecy of Amos, have rendered the name of a conſtellation, which in the original is Cheſil, by the word Orion. It will be ſhewn there, that they did this quite at random; as, in reſpect to the others, only putting one or other of the names of the few old conſtellations for ſuch few as they found named by theſe writers. It will be proved that Chimah, which goes before this word Cheſil, and is rendered Pleiades, is the oriental name of Orion, and that Cheſil is the name of the Bear, which was at that time called the waggon or wain, Amaxa, and that this only conſtellation, of all in the heavens, could be intended by the word. Where the expreſſion, looſe the bands of Cheſil, is uſed, to what of all the conſtellations is ſuch a phraſe applicable, except to this which was repreſented as a waggon drawn by three horſes, harneſſed or bound to it? and when we find Iſaiah afterwards ſpeaking of it in the plural number, for ſo he does in the thirteenth chapter; the word that is tranſlated conſtellations being Cheſilim, the plural of Cheſil, what could he mean but the two Bears? He denounces this as a vengeance on a wicked people; he ſays, the ſtars of the heavens and its Cheſilim ſhall not ſhine bright; and as it is evident by this, that he intended to expreſs two conſtellations in the hemiſphere which were of the ſame name, and were of vaſt uſe to mankind, ſince the darkening of them is threatened as a terrible vengeance; it is as evident that only the two Bears, or two wains, the Urſa Major and Minor, could be intended in that paſſage.

As this is certain, and will be ſupported by many other proofs in its proper place, it appears that the Bear has been mentioned in the ſame place, even in the ſame ſentence, with this conſtellation, and therefore it cannot be the ſame

with

with it; and that as Chesil is certainly the Bear, Aish, which follows, as certainly is not. The whole sentence is, "Canst thou "bind the sweet influence of Chimah, or "loose the bands of Chesil? Canst thou "bring forth Mazzaroth in its season, or guide "Aish and his sons?" Nothing can be more palpable, than that Chesil is the Bear in this place, from the other passage, in which the same word is used; and it is surely as certain, that, if Chesil is the Bear, Aish is not: so much therefore is proved beyond contradiction.

We find the origin of this strange opinion, which would make the Aish of the scriptures the Ursa Major of the astronomers, is no other than a mistake of one of the old Hebrew commentators on that part of the bible; who, having found in some books, now lost to us, or received from some not-understood tradition, an account that Aish was the Seven Stars, was so ignorant of astronomy (for all the Jewish interpreters of the bible were wholly ignorant of it) as to suppose that the Seven Stars meant the Bear or Wain. From him all the list of commentators that followed, borrowed it; so that their testimony rests only on the merit of his. But beside these, there are produced, in support of it, the Arabic accounts of that constellation which call it (as observed) by a name not very different in sound or orthography from that of Aish, and call part of the stars which belong to it by this very name of its sons. This has indeed an appearance of something, but 'tis easily shewn to be no more than an appearance, for the names are indeed not near enough, according to the customs of those languages, to have been borrowed from one another; and as to the expression of its sons, with regard to the Bear, it is so far from being of antiquity enough to countenance the opinion of those who would make this constellation the Aish of the book of Job, that it was probably the child of that opinion; and while produced as an authority, is indeed dependent on it.

We are apt to look upon the Arabian astronomers as very antient, and it is possible, and it is also probable, that observations of the stars, serving to the purposes of life, were very early in use among them; but their astronomical writings are very late, nay, the very introduction of writing among them is little earlier than Mohammed. From this single observation it will appear how very idle it is to look up to the writings of the Arabs, as monuments of the early astronomy. They translated their astronomy solely from the Greek, and the oldest catalogue of the stars, in their language, was made but between eight and nine hundred years ago. Their names of the constellations in general are only translations of the Greek words, by which they were called, into their own language, and such is the word Naish among them: it is their rendering of the Greek word Amaxa, a waggon; a bier being not very different, and the word Amaxa signifying chariot, wain, waggon, or almost any other convenience of carriage. As to their constellations of the Mule for Auriga, the Crane for Ophiucus, and the rest; it is not to be supposed they are original, and were therefore preferred to those of the Greeks: their law forbade them to draw the representation of an human figure on any occasion whatsoever, and such as they found in the sphere of the Greeks of this form, they were obliged to alter. We know not exactly how early the error of supposing Aish to signify the constellation Ursa, may have been, but it is very possible that the calling of the stars in the tail of that constellation, its sons, which is urged in favour of supposing it to be so, might be done in consequence of the Arabians hearing that the Bear was a constellation named in some old books, with the addi-

tion

tion of such a term as expressed its sons; and they might therefore apply this term, its sons, to those stars in the tail.

The antients do not seem to have been perfectly agreed about the place of the star Arcturus, or about the identical star which they should call by this name, and yet they are express in the imagined influences for which they feared it. Vitruvius says it stands between the two knees of Arctophylax, which is the situation we give it, and seems to express the same star; but Germanicus and others place it in the girdle or belt of Arctophylax.

Arcturum dicunt sidus qua vincula nodunt.

So that they either brought the waist of that figure much lower than we do at present, or else they gave the name of Arcturus to another star. But whatever inconsistence may be among them about the place or identity of the star, there is none about its influence; they all speak of its foretelling, and the warmest of them as occasioning tempests, particularly at the time of its setting. Horace alludes to this, when, in describing the unruffled tranquillity of the moderate man, and calling up the images that might most disturb the adventurous and avaritious, he says, tempests do not discompose him; and, to express that, uses the name of this star in its situation of setting.

Neque tumultuosum sollicitat mare,
Nec saevus Arcturi cadentis
Impetus, aut orientis Haedi.

Plautus is more express and strong; Horace, like the generality of the antients, makes it only presage storms at its setting; but this author gives it the same power, though in a less degree, at its rising. He introduces the star itself speaking.

Increpui hybernum, et fluctus movi maritimos
Namque Arcturus signum omnium sum acerrimum
Vehemens sum exoriens; cum occido vehementior.

AREA. Astronomy borrows this term from the mathematics to express the surface, or the quantity of surface, contained within the lines which form a figure. *See* FIGURE.

AREA *of a Circle.* The quantity of space contained within the out-line of a circle. This is sometimes expressed by the term circle absolutely used: but it is better to use the proper term. *See* CIRCLE.

ARGO. A name given by some of the old astronomers to the constellation, more usually known by the name of the Ship, it stands near the great Dog. *See the article* NAVIS.

ARIADNE's CROWN. A name by which some have called the constellation, more usually known by the name of Corona Borealis, or the Northern Crown; it stands between Bootes, Hercules, and the head of the Serpent, and is a little constellation with but a few stars in it. It has obtained the name of Ariadne's Crown from the Grecian fable, that Bacchus, when he married that beauty, placed in the heavens the crown, which Venus gave her as a nuptial present. The constellation is remarkable for a bright star of the second, or, as some others will have it, of the third magnitude, which is called Lucida Corona.

ARIES. The Ram, one of the constellations of the northern hemisphere, and one of the old twelve signs of the zodiac; it is the first in order of the twelve, and one of the divisions, containing a twelfth part of the ecliptic, takes also its denomination from it.

It is a constellation of very considerable note, and though not so large as many of the others, nor so thick beset with stars as some of them, nor even having those stars in general so large as they are in many, yet it has a sufficient number that are of a size and lustre to make it conspicuous.

It is represented in all the figures of the heavens in form of a Ram, in a sitting posture, with one foot extended forward, and the other three drawn up under the body; the tail is protended strait from the body, and the head is turned so as to look behind it. The figure is generally better drawn than that of many other of the constellations. Many of the animals of the astronomers are no more like to those on the earth, than the creatures of our modern heralds are to any thing in nature, their dragons having hair upon their heads, and the like absurdities; but this is not of the number. It is in general as good a figure of the animal as could come from the hands of a painter.

The constellations, between and among which Aries is placed, are the Whale, the Bull, the Triangle, and the Fishes. The Triangle is over the Ram's head, the Fishes are in front of it, the line which connects them passing very near the protended foot; the Whale is directly under him, the head of that creature coming just to his belly; and the Bull is close at his tail, his head being turned in the contrary direction.

The antients counted only eighteen stars in Aries, nor is it a wonder. There are more, but the greater part of them are very small. Ptolemy sets down this number in his catalogue, and we know he was a strict copier of Hipparchus in this particular. Thus stood the account to the days of Tycho Brahe, and he encreased the number only by three stars; even Hevelius, with all his discernment, raised it afterwards to no more than twenty-seven, and it was not till the observations of our Flamstead, that we saw the number much more enlarged: he has set down sixty-six stars in the constellation, taking into the account those over the head, and near the Triangle, which are always called the unformed stars belonging to the constellation Aries.

In the whole constellation of Aries there is not a single star of the first, or even of the second magnitude; there are only two that are so large as of the third; one of these is at the root of the horn on the right side, and the other is the brightest of the Informes, and out of the figure. There are but few even of the fourth, and these are toward the head, one of the most considerable is on the left horn. The rest are principally of the sixth, and the yet smaller classes. They are disposed irregularly over the figure; one of the largest, beside those already particularised, is toward the tip of the left horn, and two others are in the tail. The greatest part of the others are on the hinder part of the body, the breast and legs having only a few.

There is great reason to suppose, that all the forty-eight old constellations were brought among the Greeks from the Egyptians; but this is more palpably than all the case with regard to the signs of the zodiac: and what is yet more singular, if we trace them to their origin, we shall find them of earlier date even than the inhabitants of Egypt; for it is certain, that could not be the country in which they were formed: the several seasons of harvest and rains, and the like, which are evidently expressed in the figures, either having no place at all in the country, or happening at a period of the year very distant from that at which the sun enters those constellations, and which was meant to be signified by them. For instance, the wintery constellation Aqua-

rius was intended to signify rain, but there is none in Egypt; and the constellation Virgo, which was in its origin no other than a female reaper, with a sheaf of corn, was intended to mark the time of harvest; but the harvest in Egypt is not in autumn but in spring, in April not September. It is plain therefore that this division of the heavens was made somewhere else, and not in Egypt, and that the colony who went from that place, probably the plain of Shinar, into Egypt, preserved the astronomy they had learned from their fathers, though it no longer was appropriated to the country in which they were. Thus much may be judged necessary to premise on enquiry into the origin of that figure which marks the first place in the zodiac, as it will lead toward an understanding all the rest.

The Greeks, whether they did not discover, or did not care to allow any thing of this kind, always talk in the strain of inventors when they treat of this subject. They give us, according to their custom, a very plausible account of the origin of this constellation, and refer it to a part of their own fabulous history. They tell us, that this Ram was the same with that which was the origin of the famous Golden Fleece that Jason carried off. The story they give is this; Nephele gave Phryxus, her son, a Ram, to be a safeguard against the greatest perils. Juno, the step-mother of him, and Helle, laid designs against their lives, and Phryxus, remembering the admonition of his mother, took his sister with him, and, getting on the back of the Ram, were carried to the sea. The Ram plunged in, and the youth was carried over, but Helle dropped off and gave name to the Hellespont, where she was drowned. When he arrived in Colchis, Æta, the king, received him kindly, he sacrificed the Ram to Jupiter, and dedicated the fleece to the god. This Jason after bore away. The animal itself, they say, Jupiter snatched up into the heavens, and made of it the constellation Aries. They have other fables also to account for its origin, for they are very apt to vary in their stories upon these occasions, but it will be easy to trace the Ram in the heavens up to a better origin.

We are to consider then that the first business of the earlier people, was the providing the necessaries of life; this was to be done by cultivating the earth that was before them, and tending those flocks which they found upon it. These and their corn were their great riches, and it was with respect to distinguishing the seasons that marked the several times for the necessary care of these, that they first of all regarded the course of the year, or variety of the seasons. They saw the return of the spring call up the grass, and they saw the same season give strength to the young of the several domestic animals; they found the sheep the earliest of these in its produce, and they marked the time of the sun's return to a certain part of the heavens, as the period at which this return of the spring was made; and the vegetable and animal word imbibed this new life. They wanted to place a mark upon that part of the heavens at which the sun's appearance promised all this happy influence; and there was no way of marking a part of the indefinite space, but by means of the stars with which it was beset. These, irregular as they stood, could only serve the purpose, by having a certain number selected and arranged under some figure.

For several stars, that, in themselves, stood so irregularly over the space to be marked, the out-line of one figure would do as well as that of another. They were accustomed to hieroglyphic writing, or to express their sentiments by the figures of animals instead of characters

and

and letters, and what was ſo natural as to continue the cuſtom. They expected the coming of this time as the period of their increaſe in the flock: they were to aſcertain the ſtars that marked that ſpace at the return of the ſun to which they knew this period always arrived, under the figure of ſome animal; and what was ſo natural for their choice as the animal itſelf, for whoſe ſake the obſervation was made. They placed the father of the flock in the ſpace, that is, they deſigned, on paper, the figure of a Ram, and in the ſeveral parts of that figure they marked down the ſtars that occupied this ſpace. From ſtudying this in the cloſet, it was eaſy for a man to underſtand it in the heavens, and it grew familiar to know thoſe ſtars, and no others, under the name of the Ram, and ſo underſtand that the ſun's return to them betokened the coming of the ſpring. In the ſame manner a Bull was placed next in order, the produce of that animal being a little later in the ſeaſon than that of the ſheep; and after that the Goat, the lateſt of the three. This they expreſſed not by one, but by two kids, for that was the original conſtellation of Gemini, and ſeemed to ſay by it, that if the produce was late, it was alſo double, which is conformable to truth, the goat uſually bringing forth two at a time, the cow and the ſheep only one.

This is the moſt natural origin of this conſtellation, and it will lead us out of the idle fables of the Greeks toward the true knowledge of the others. It is familiar and ſimple, and it is therefore ſuited to the primitive plainneſs of the times, and it regarded their greateſt concerns. They have, on theſe occaſions, alſo contrived very happily, under the figures of theſe animals, to diſpoſe the principal ſtars in ſuch conſpicuous parts of the creature's figure, that they could at all times know how to refer to them, or to ſpeak of them without trouble. Thus the three principal ſtars of Aries are in the horns of the animal, and the moſt conſiderable after theſe in the tail. And in the ſame manner in Taurus great ſtars are in each eye, and another at the tip of the horn. Thus there was at once ſimplicity in the contrivance, and art in the diſpoſition of the ſtars, and they ſerve to many purpoſes.

The antients paid great reſpect to the Ram, as the firſt of the ſigns of the zodiac. They talk of its golden fleece, and call its horns thoſe of Jupiter Ammon. Manilius makes him the ſovereign of the conſtellations, as well as of their leader; in his firſt book he calls him the Princely Ram, and paints his glittering fleece, and, in the ſecond, in the ſame manner calls him,

Aries caput eſt ante omnia princeps
Sortitus.

And in a ſucceeding line,

Conſilium ipſe ſuum eſt Aries ut principe dignum.

And Columella, (for the royal character of this conſtellation was univerſally allowed) calls him ſovereign of the flocks and ſigns.

Signorum pecorumque princeps.

We find ſtrange honours done to the animal itſelf in the affairs of the world among the early Romans, and this was all derived from the regard they paid to the conſtellation. The old doctrine of the creation placed the Ram in the middle of the heavens, ſeated as it were on a throne, and looking down upon the newformed world; and it was hence they made this ſign the firſt of the zodiac, the beginning or opening of the year, and the ſovereign of the heavens. The Agnalian feaſts were, according

ing to Varro, celebrated by the ſacrifice of a Ram, the Princeps Gregis, thoſe are his words. The Ram, among that people, was a ſymbol of principality. We ſee on ſome medals of Domitian, a Ram on the reverſe, and the words Princeps Juventutis, and even the Greek name of the creature Κριος, is taken as a name of a ſovereign. On this foundation we ſhall not wonder at the reſpect we ſee paid by the aſtronomers of the earlier ages to the conſtellation Aries; or that the Judaical aſtrologers, when the credulity of the world countenanced them, always applied to the Ram by ſome way or other, when the fortune of kings was to be determined or foretold. We paint the conſtellation as a Ram of full ſtature, and by his horns as of ſome age; but the names, by which it is called in the oriental languages, ſignify a Lamb, and not a Ram. Theſe nations firſt taught us the ſign, and we ought to regard their appellations.

The antients attributed a month in the year to each of the twelve principal of their deities, and as they gave to each a month of the year, they alſo placed under the immediate care of each, one of the twelve ſigns of the zodiac. The Ram naturally fell to the ſhare of Jupiter, as being the emblem of ſovereignty, and lord of the conſtellations. Thus declare the followers of Pythagoras, who in this, as in many other of their doctrines, followed the Chaldæans. And thus we are not to wonder at that imaginary analogy on which the aſtrologers, who are alſo followers of the Chaldæans, talk of the alliance between the planet Jupiter and the ſign Aries.

ARIES, *the point of.* The ecliptic is inclined in an angle of twenty-three degrees twenty-nine minutes, or thereabouts, to the equator; and this laſt circle cuts or interſects the other in two points oppoſite to one another. Of theſe two points, that, in which the ſun is ſeen at the time of the vernal equinox, is called the point of Aries; that, in which it is ſeen at the time of the autumnal equinox, is called the point of Libra. *See the article* CIRCLES *of the ſphere.*

ARITZ. A name by which ſome, who are fond of uncommon words, have called the planet Mars; it is an oriental word, and it expreſſes, in the original ſignification, ſtrength.

ARK *of Noah.* A name given by Schiller to the conſtellation Argo, or the Ship.

ARK, or *Ark of the Covenant.* A name which Schiller, in what he calls his reformation of the ſphere, gives to the conſtellation Crater. Others of theſe enthuſiaſts call it the Cup of Joſeph, or the Cup of the Sack. Theſe are more pardonable, becauſe they do not alter the figure.

ARMELATES, *or* HARMELATES. A term by which ſome expreſs Auriga. It is one of the old Greek names of that conſtellation, and ſignifies the ſame as Auriga.

ARNEB. A name by which ſome, who are fond of uncommon words, call the conſtellation Lepus. Arneb is the Arabic name, and ſignifies an hare.

ARNEBETH. The ſame with Arneb. A name given by ſome to the hare Lepus. It is the Hebrew name of the conſtellation, and in that language ſignifies an hare.

ARROW, *Sagitta.* A name of one of the conſtellations of the northern hemiſphere. *See* SAGITTA.

ARRUCHA. One of the many names by which aſtronomers have called the leſſer Bear; it is a miſ-ſpelling of the Arabic Al Rucha, which is one of their names for it.

ARSK AL SIMAK. A name by which ſome, who are fond of uncommon terms, have called the conſtellation Corvus; it is one of the Arabic names.

ARSLAN, *or* ASLAN. A name ſome writers give to Leo; 'tis the Turkiſh appellation.

ARTES. A name given by thoſe, who are fond of uncommon words, to the planet Mars; it is alſo a name of the pagan deity of the ſame denomination.

ARTIFICIAL DAY. A term by which aſtronomers ſometimes meaſure time; it is very different from the natural day, being much ſhorter. The natural day laſts from twilight to twilight, but the artificial day is only that ſpace of time in which the ſun is above the horizon, or that number of hours and minutes which, on any given day, are between its riſing and its ſetting; and in the ſame manner the artificial night is that ſpace of time in which the ſun is underneath the horizon; not thoſe hours only in which there is darkneſs.

ARYE. A name by which ſome, who are fond of unuſual words, have called the conſtellation Leo; it is the Hebrew name of that ſign. *See the article* LEO.

ASAD, *or* AL ASAD. A name by which ſome of the old writers have called the conſtellation Leo; 'tis the Arabic name of the ſign. They ſay the Arabs have between ſeventy and eighty names for a lion, when they ſpeak of that creature on the earth: if it be ſo, 'tis greatly to their honour that they have taken away the occaſion of confuſion by applying only one of theſe to the conſtellation of that name in the heavens.

ASBILA. A name by which ſome, who are fond of uncommon words, have called the conſtellation Draco; it is one of the old Greek names of that conſtellation.

ASCENTION *right*. That diſtance which is between the point of Aries, and that point of the equator to which the circle of declination of a ſtar correſponds. *See the circle of the* SPHERE.

ASCII, *having no ſhadow*. A term that has been uſed by the antient aſtronomers and geographers to expreſs thoſe who lived in ſuch parts of the earth that the ſun was at ſome time of the year vertical, and conſequently their bodies at this time caſt no ſhadow: for when the ſun is perpendicular over any thing, the ſhadow is not extended on either ſide, but falls on the very ground on which the thing itſelf ſtands, and conſequently is not viſible. The allowing that there were ſuch a people as were hence called Aſcii, or ſhadowleſs, was in effect contradicting the general ſyſtems of the times, for theſe could, for very certain reaſons, be perſons who lived no where but in the torrid zone, and that torrid zone they held uninhabited, and indeed, by reaſon of its great heat, not inhabitable.

We are to conſider, that the torrid zone extended from one to the other tropic, as the temperate reached from either tropic to the polar circle, and the frigid zone from the polar circles to the poles. Now the ſun's declination, north and ſouth from the equator, is

tran-

terminated within the compass of twenty-three degrees each way from the equator, and this is the exact limit of the torrid zone. The sun can be vertical in no place except where the latitude is just equal to the degree of his declination; and all the latitudes that are equal to any of the degrees of the sun's declination, north or south, are within the tropics, for they also must be within twenty-three degrees and a half of the earth's equator: and all places that are so, are within or between the tropics, that is, they are part of the torrid zone. It follows therefore, that when the antients gave the name of Ascii to any people, they allowed of people who lived within the tropics, and they allowed in effect that the torrid zone was habitable, since these people must live in it.

We are not to understand however by the term Ascii, that there are people who never have any shadows at all, for this want of shadows to those who are within the limits of the torrid zone, and who are the only persons to whom it can happen, is only on two days in each year. Under the equator, it is on the two days of the equinoxes, on the tenth of June and twelfth of September; and in all other places within the due limits it is twice a year also; and happens at the sun's passing and repassing them, in his declination toward the tropics, and return to the equator. This will serve also to explain another term of the antient astronomers Amphiscii, by this they meant people who from the part of the globe on which they lived, had their shadows at some times of the year extended to the north, and at others to the south of them. It will be easily understood that this must be the case of all who lived in any part of the torrid zone within the limits of its very confines, for at the confines the shadows must fall only one way, and at the time of the sun's being vertical, they must loose them, and become Ascii. It was the ignorance of the antients, as to the true situation of these places, that made them look upon the Ascii and Amphiscii as different people; for except the single instance, just given, of people who lived on the confines of the zone, all those who were Ascii at one time, must be Amphiscii at others.

It has been observed, that the sun is continually changing his place in the heavens, going from the equator to either tropic, or returning again from the tropic to the equator. Now the term Ascii was characteristic of the people only on two days of the year in any of these places, and in the other time their shadows were sometimes on one side, and sometimes on the other, so that they were Amphiscii. Thus at the equator, on the tenth of March, the people are Ascii, for the sun being vertical they have no shadows, and in the same manner again on the twelfth of September. But at other times, the sun being declining to the northern tropic, their shadows were at that time south, and afterwards the sun being declining towards the southern tropic, their shadows were thrown northward. In the same manner the people inhabiting any part of the torrid zone between the equator and either tropic, have the sun two days in the year vertical, and are Ascii; that is, as the sun passes their zenith in his way from the equator, and in his way back again: and at other times they have their shadows to the north part of the season, and to the south another part, as the sun is not yet advanced to them, or is beyond them in his course; so that there are to them, as to those that live immediately under the equator, only two days on which they are Ascii, or have no shadows, and for all the other part of the year they are Amphiscii.

ASEL-

ASELLI. A name given by the Latin astronomers, in imitation of the Greeks, to two stars in the constellation Cancer. They are situated near the single star in the breast of that sign, which is called from the same authors Præsepe. The Greeks had a custom of giving particular names in this manner to certain single stars, or clusters of stars in the constellations. They called the five stars in the Bull's face Hyades, and the little cluster in his neck Pleiades. The Arabian, as well as the Latin astronomers, have imitated them in this, and it is of use: some of the names are aukward and ill-sounding, but they serve very well to mark what we speak about.

ASH. A name given by some to the bright star towards the shoulder of the constellation Auriga, called the Goat, and the Amalthæan Goat, and the mother of the two kids, the two bright stars in the arm of the same constellation. The word Ash is the Hebrew name of the same star.

ASHDENA. A name by which some of the astronomical writers have called the constellation Draco; it is the Persian name for that constellation, and the word properly signifies a serpent. The Hebrews called it Tannin, and Fleuban.

ASLAN. A name by which some have called the constellation Leo; 'tis the Turkish name of that sign, and they sometimes write it Arslan. *See* LEO.

ASMEAT. One of the names by which those, who love to write obscurely, call the Centaur; it is one of the Arabick names of that constellation. They call it also Albere.

ASPECTS. A favourite term among the astrological writers, and one that was very early in use. Indeed this is not wonderful, since astrology was blended with astronomy in the earlier days of that science, and those who professed the one were the same who studied the other; nay, in many cases, one was only studied for the sake of the other, and a true and noble science made the slave and tool of a false one.

We find the oldest authors, who have written on astronomy, mentioning these Aspects; by the term is understood the mutual radiations of two or more heavenly bodies within a certain distance. Thus there are Aspects spoken of between planet and planet, but the most frequent are those between certain planets and certain fixed stars, or certain planets and certain constellations; the whole of which constellations, or the principal stars in them, or the single fixed stars in the other instance, are supposed of the same nature with the planet. These are the terms of the old doctrine, and what they mean by the planets, and such and such particular stars being of the same nature, is, that they have the same tinge in their light. This is a curious observation, and it has its foundation. The light of each of the planets has its peculiar tinge, that of Mars ruddy, Venus yellowish, Saturn bluish, and so of the rest; and there are certain fixed stars which have the same tincts. This was a Chaldæan observation, and is very just, but it is most distinctly seen in countries where the air is clearest. Jupiter is the only planet whose light is perfectly bright and silvery, and consequently all the fixed stars, which have no peculiar tinge, are said to be of the nature of Jupiter; and the others respectively of those planets whose colours they emulate. On this in a great degree depended the doctrine of Aspects; and under these advantages the old astrologers supposed that they had certain relations to one another,

and, when they came within a determinate distance, co-operated together.

The greater Aspects were five, and they were distinguished by names answering to the number of degrees of distance. They are called, 1. Conjunction, 2. Sextile, 3. Quadrate, 4. Trine, and 5. Opposition. The conjunction is when they are together, the sextile when at sixty degrees distance, the quadrant when at ninety degrees, the trine when at one hundred and twenty, and the Aspect of opposition, when at half the circle, or one hundred and eighty degrees distance. The writers, who are fond of multiplying terms, have added to these, but these are the original and the most considerable Aspects.

But the most eminent of all Aspects are the great conjunctions of the three superior planets, and their distances in trine Aspects of the zodiac. These the astrological writers have called Triplicities, and of these they always speak with the greatest enthusiasm. These are of three kinds according to their distinction, and hence are the famous words of fiery Trigons, aerial Trigons, and watery Trigons.

The fiery Aspect is the first and greatest, and its angles answer to the fiery signs, as they call them; these are Aries, Leo, and Sagittary. The second is the airy Aspect, answering to what they call the airy signs Gemini, Libra, and Equarius, though one would think the last should have been one of the watery ones; and the third is the watery Trigon, pointing to the watery signs, Cancer, Scorpio, and Pisces: to these is to be added, though less respected than the others, the earthy one, answering to what they called the three earthy signs: these were Taurus, Virgo, and Capricorn. These were the aspects of the greatest note among them, and it was from these they calculated the boldest of their predictions. We are happily arrived at a period, when real knowledge has laughed these fancies out of the world, but it may be necessary just to shew, what was meant by the words, that no part of the science, of whatever period, may be utterly neglected; nor any term, however obsolete, or idle, met with, the meaning of which may not be known.

ASPHOLIA. A name by which some fanciful people have called the constellation Virgo. It is the Coptic name, and, in that language, signifies Statio Amoris. They call the constellation Cancer, Statio Typhonis. It is not easy to say what the terms mean.

ASTAROTH. A name by which some, who love uncommon words, call the planet Venus. It is one of the old Chaldee names for that planet, and signifies conspicuous.

ASTERION. A name of a constellation, or rather half a constellation, of the northern hemisphere. It is a part of one of those new ones added by Hevelius to the forty-eight old, and designed out of the unformed stars. The whole figure consists of a pair of Greyhounds, the other is called Chara, they are held by Bootes, and seem barking at the Great Bear. *See* CANES VENETICI.

ASTERISMS. A name used by some for what are more generally called constellations, arrangements of certain of the fixed stars which are near one another, into the imaginary forms of beasts, and other things, for the sake of speaking of them with familiarity.

It was but by very slow degrees that the Greeks arrived at all that knowledge of these asterisms, which was necessary for their perfecting their astronomy, to the height to which they at length carried it. They had the first knowledge of this division of the heavens from the Egyptians, who had preserved

it

it from the time of their original ſeparation from their brethren, and going to the borders of the Nile. It is evident, that the twelve ſigns, or, as they were called, Aſteriſms, of the zodiac, were not firſt deviſed in Egypt, although the knowledge of them was carried thence into the reſt of the world. Virgo, with her ears of corn, denoted the harveſt, or marked the time when the ſun entered that part of the heavens to be at the reaping ſeaſon; but this was not invented in Egypt, becauſe there Virgo would have been the ſign for March, the month of their harveſt, though not of the reſt of the world. It is plain, therefore, that the Egyptians brought with them from elſewhere thoſe conſtellations or aſteriſms, which they afterwards propagated among the reſt of the world.

Theſe were about forty-eight in number, and we find ſome of the Greek poets, nay, the very oldeſt among them, mentioning ſome of them. Homer and Heſiod mention ſeveral, as things familiarly known in their time; and Aratus the poet, whom St. Paul has honoured with a quotation in the New Teſtament, wrote profeſſedly upon them. He has however treated them, though very prettily, yet with little real knowledge; all that was intended by his works, was the pointing out their uſe to ſailors in thoſe little voyages which were undertaken in his time, and to the farmers for the plowing and ſowing their lands. Hipparchus wrote more in the manner of a ſcience, and with a view to general uſe, and the world has indeed been greatly obliged him. Ptolemy was ſenſible enough of the value of his obſervations, and has kept to them in many places where he does, and in many where he does not confeſs it, with a religious punctuality: it was Hipparchus, who, of all the authors we are acquainted with, firſt treated their aſteriſms like an aſtronomer, aſcertaining the places of the ſtars. We have the names of ſeveral other of the Greeks who have written on the aſteriſms, or conſtellations, but little is recorded of them that is of any conſequence: the figures into which they arranged the ſtars in the ſeveral conſtellations, were the ſame with thoſe their predeceſſors had learned from the Egyptians, and ſuch we have them preſerved by Ptolemy: as the predeceſſors of Ptolemy had been careful not to deviate from the original form of the conſtellations, as they had received them; thoſe who have followed him have taken as much care to conform themſelves to his account of them. He has left us no delineations of the forty-eight aſteriſms he treats of, which is a great pity; but he has been ſo accurate in his deſcriptions of them, that it has been eaſy to preſerve them in the ſame form. We have of late times added about twenty-eight to the number, and theſe we have treated as we pleaſed, but there has been a religious care to avoid alterations in the old ones, and to this it is we owe it, that we can at this time ſpeak of the ſeveral fixed ſtars, naming the places they have in the ſeveral conſtellations within this number, as regularly as if they had all ſeparate names, and had been known alſo to the antients, and in all ages by thoſe names. Fools and enthuſiaſts have indeed been deſirous to alter the heatheniſh names and figures, and to advance the bleſſed Virgin into the place of the Bear, and the twelve Apoſtles into the zodiac, in ſtead of the twelve ſigns; but none have liſtened to them.

We ſhall find, on comparing the account of the ſtars in the ſeveral conſtellations, that in the earlier periods of aſtronomy, only the principal or larger were taken notice of, but theſe ſerved all the purpoſes of diſtinctions which they wanted. What much encreaſes the ſeveral liſts is, that in ſpeaking of a conſtella-

ſtellation, we take in the ſeveral unformed ſtars into the account, or thoſe which lie immediately about the figure, although they are not comprehended within its out-lines; and are not made a part of any other. This is proper, becauſe elſe we can take but a very wild account, nor are able to name them with any degree of preciſion. Indeed the number of theſe unformed ſtars, which were a diſgrace to the old diviſion of the heavens, is, at this time, greatly diminiſhed, from the modern aſtronomers having formed ſeveral new conſtellations out of them: thus the unformed ſtars about the Eagle have been received into Antinous, and thoſe near the tail of the Lion into Berenice's Hair; and Cor Caroli, Charles's Heart, has been made the diſtinct name of a ſtar of the ſecond magnitude near the Leſſer Bear. This gives us ſtill more means of talking with the due preciſion. The Greeks had a way of doing ſomething like this, they gave particular denominations to little cluſters of ſtars, although they were already parts of ſome other conſtellations, and ſometimes to ſingle ſtars; but it had been better to have given them to ſo many of the unformed ones.

People have been led to believe, that the aſteriſms or conſtellations were formed by the Greeks, becauſe they are made to refer to parts of the Greek hiſtory or fable; but there is no foundation for this; the conſtellations were much earlier than their times, and they retained them as they were, but adapted parts of their hiſtory or fable to them. It is to be obſerved, that the Greeks gave names to certain little cluſters of ſtars, and to ſome ſingle ſtars, which were before a part of other conſtellations, the Pleiades in the Bull's neck, the Hyades in his face, and others are of this origin, and we find theſe mentioned ſo early as in Heſiod and Homer; but then we find in the ſame authors the names of Sirius, derived from Siris, the Nile, which began to ſwell at the riſe of that ſtar, as alſo of Orion, and others, evidently foreign, as familiarly treated among them. Muſæus is recorded to have been the firſt who drew the figures of the conſtellations on a globe among the Greeks, and this Muſæus being father to Orpheus, one of the Argonauts, it has been ſuppoſed, nay Sir Iſaac Newton, in his Chronology, countenances the opinion, that the ſigns and figures he laid down upon the globe had reference to the heroes concerned in that expedition, or to ſerve one or other of the remarkable occurrences of it. It is with perfect juſtice that this author ſays none of the figures among the conſtellations have reference to any thing of later date than that expedition; but 'tis unqueſtionable that moſt, if not all, of the old forty-eight conſtellations, were formed before that time, and that all Muſæus did was to adapt that ſtory, or the ſeveral parts of it, as the other Greeks did afterwards other parts of their hiſtory, to the figures which he found already in uſe with all who ſtudied the heavens; and which had originally been brought from among the Egyptians. The people, who have endeavoured to adapt the general hiſtory of the Greeks to theſe figures, frequently diſagree among themſelves, ſome taking one, and ſome another part of it, to anſwer to the ſame conſtellation: and it is evident, from many inſtances, that the Greeks had theſe conſtellations in uſe among them for marking out the ſeveral parts of the heavens, long before any one attempted to reconcile them to their hiſtory. Thoſe, who ſucceeded at equal diſtance to the perſons, who had firſt introduced them in Greece, might be ignorant of their having been brought from elſewhere, and thence might fall upon the enquiry of what they referred to in their

ſtory who they ſuppoſed invented them; but as they were indeed deviſed elſewhere, and had in reality no ſuch reference, all muſt have been error and confuſion in the ſearch.

It is undoubted that the Egyptians, whether themſelves invented, or whether they only brought the conſtellations away with them when they ſeparated from the reſt of mankind after the flood (which latter is moſt probable) were the people who taught them to the Greeks; and that the figures of them, which were thus received from the Egyptians, were never altered by the Greeks, although they, in after-ages, endeavoured to make them relate to their hiſtory. When they had a mind to place ſome favourite hero among the ſtars, or to commemorate ſome memorable exploit, or great atchievement, they looked up to ſome of the conſtellations already formed, and found a reſemblance, and then, whether or not they perſuaded themſelves, they took ſome pains to perſuade others, that this was the origin of the ſign. But even in this they were confuſed among themſelves, for the conſtellation Gemini, which was, among the Egyptians, nothing more than the repreſentation of a pair of kids, and was only intended to expreſs that the ſun's entering that ſign denoted the time of the prolific Goat's bringing forth her young, was to be made Greek, and two heroes were to be placed in the ſtead of the kids. But in this they do not agree who thoſe heroes ſhould be; the generality call them Caſtor and Pollux, but there are ſome who make them Apollo and Hercules, and others Triptolemus and Jaſion. We may ſee by this, as well as by other inſtances, that the figures of the conſtellations are very old, and that the Grecian hiſtory did not originally give the form to them, but was afterwards only applied to them in compliment to different perſons, but they have not kept ſo ſtrictly to their originals, ſuppoſing them to have received their knowledge of the heavens the ſame way. It appears from all who have written faithfully of the learning of the Eaſt, that the conſtellations of the Chineſe are very different from thoſe which are in uſe with us, and have been among the Greeks, from whom we deduce all true aſtronomy: Kempfer ſhews us alſo, that the Japoneſe, although they have arranged the heavens under the figures of conſtellations, yet have made uſe of figures quite different from thoſe of the Greeks. This will ſerve to give their aſtronomy a different character from ours, and perhaps to refer it to a different origin, but that diverſity of figures which we find among the Arabians is leſs pardonable. Theſe received their aſtronomy from the Greeks, and conſequently ought to have uſed the old figures, derived from the Egyptian diviſion of the heavens, but holding it unlawful to delineate any human form, according to the ſuperſtition of their faith, whenſoever they have met with ſuch in their way, they have ſtruck out whatſoever had reference to an image of this kind, and ſubſtituted ſomething elſe in the place: in this alſo they have ſhewn their ignorance, as well as their ſuperſtition. One of the firſt things they had to except againſt was Gemini, they could not endure the two Grecian heroes, Caſtor and Pollux, and ſo they introduced a pair of Peacocks, not knowing that the Greeks had indeed deviated from their maſters in this reſpect, and that the proper and original figure was a pair of kids, which they might have therefore reſtored with ſafe conſciences; and inſtead of confounding the ſcience, have ſo far recovered it, and ſet it on its antient, and its true foundation. Poor Aquarius is on this plan baniſhed out of the ſkies, and the figure of the conſtellation is a Mule, carrying two barrels of water: the Centaur is converted into a couple of animals,

a Horse and a Bear, which are represented fighting; the virgin is quite lost, only the ear of corn is converted into a wheat-sheaf; a mule caparisoned, but without any load, is in the place of Auriga; Ophiucus is metamorphosed into a Crane, and Hercules into a Camel. The quiver of arrows is all that they leave us of Sagittary; for the Grecian Cassiopeia they place a Quadrupe, a Dog, but they preserve her chair, and very decently place that creature in it. The unfortunate Andromeda is changed into a Phoca, or Sea Calf, and poor Cephus into a Hound. Bootes is displaced also, but the figure they have substituted is not to be referred to any known creature.

Some of the asterisms seem to have been thrown into form in the very earliest ages of the world, probably before the race of mankind, which succeeded the universal destruction of the deluge, separated from one another, to form so many nations. We find the names of Sirius and Orion familiar in the earliest writers; Hesiod frequently mentions them, and as frequently the Pleiades, Hyades, and Arcturus; these seem to have been added by the Greeks, but the two others were doubtless of foreign origin. The very sound of the several words import as much.

ASTRONOMY. The general name of that science, the explication of the several parts of which, and of the terms used by those who have written concerning it, is the immediate business of this volume. Astronomy is the science which teaches a knowledge of the stars, and, in general, of all the heavenly bodies, their form, structure, appearances, and motions; their place or situation in the heavens; their magnitude, and their distance; a large and extensive field, but at this time greatly cultivated, so much indeed, that very few improvements can be expected to be hereafter made in it; very little being unknown of all that it proposes to teach.

Astronomy serves to regulate the times and seasons, determining the course of the year, and the length of its several parts, months, days, hours, and the like. 'Tis by its assistance that we are able to discover the magnitude and the form of the earth, for that globe revolving round the sun in the same manner with Saturn, Jupiter, Mars, Venus, and Mercury, is considered, in astronomy, as a planet: and it gives to geography the situation of the several parts of this globe with respect to one another, their extent and limits. Navigation owns it as the great guide, and it was with the one that the other became improved and flourished.

We read of astronomy, or some part of its discoveries, in the earliest authors that are extant, and they treat of it as a thing long before them, cultivated and carried to great lengths; nor indeed is it to be doubted that it was one of the first sciences considered. The heavenly bodies are, of all visible objects, those which must have first attracted the regard of men; they are the most conspicuous, the most beautiful, and the most important. It was natural to consider them, and they must have been very early found the only means of determining different periods of time, for establishing the necessary order and regularity in all the offices of government and religion. The oldest books distinguish the periods of days, months, and years, and the annual, or otherwise ascertained returns of certain ceremonies, for all which the observation of the heavenly bodies must have been previously made; nor could any offices, sacred or civil, be ascertained, in point of their duration, without it.

If we believe Josephus, we shall trace up the origin of the science very high. He tells us,

us, that there was a prediction of the first man, that the earth should be destroyed by water and by fire, at two different periods. He speaks of discoveries in astronomy so early as in those days, and makes the esteem, in which they were held, to be so great, that it was one of the greatest objects of their care to perpetuate them against one, at least, of these two great catastrophes. He says, the sons of Seth erected two pillars, the one of brick, and the other of stone, on the which they severally engraved what they, and what their father, had discovered of the motions of the heavenly bodies, that if one of them perished, the other might remain. This is making astronomy indeed an early science, and, if we may credit the relater of the event, there was in his time proof of the truth of it; for he says the column of stone was then standing. Seth's pillars are pretended to be preserved to this time. The possessors of the treasure, more unreasonable than Josephus, not contented with one, would preserve both, but we know how little credit is to be paid to such pretences. Josephus has so high an opinion of the utility of astronomy, that, after relating this story, he does not scruple to add, that it appeared to him one of the reasons for the length of life allotted to the patriarchs, that they might bring it to some degree of perfection: he calls in the Almighty's wisdom as operating towards it by miracle: but a miracle like this would not have been necessary. We are told, that the astronomy of the earliest times having been thus preserved, amidst the ravage of the general deluge, was cultivated by the descendants of Noah, and in the oldest profane histories we read of divine honours paid, after their decease, to those who had most improved it. Uranus, a sovereign of a people, on the borders of the Atlantic ocean, was supposed to be a descendant of the gods, because he instructed man in the history of the heavens: and Prometheus, a Scythian king, (for that appears to have been his true history) and believed to be the son of Japhet, and grandson of Noah, is celebrated for teaching his people the motions of the stars. It is hence the poets have talked of his stealing fire from heaven. And Zoroaster has left behind him an immortal name, not as one who was king of Bactria, but as he who excelled all men of his time in the knowledge of astronomy.

ASVIA. A name by which some, who are fond of uncommon words, have called the constellation Draco; it is one of its Arabic names, and comes very near to Asbia, one of its Greek denominations.

ATUD. A name by which some have called the bright star toward the shoulder of the constellation Auriga, called by others Capella, and the Amalthæan Goat. This is made the mother of the two kids, the Hædi, two bright stars in the arm of the same constellation, supposed to occasion storms and tempests at their rising. The Arabic name Ayuk, from which this Atud is formed, signifies also a goat.

AVIS INDICA. A name for one of the new constellations of the southern hemisphere, which reaches from one corner of the Triangle to the tail of the Camelion, and contains eleven stars; it is also called Avis Paradisiaca, and Apus. *See the article* APUS.

AURATUS PISCIS. A name given by some, who love new names for every thing, to the constellation of the southern hemisphere, called Xiphias, the sword-fish, but represented in the figures under the form of Serra Piscis,

the

the ſaw-fiſh. The Portugueſe, who formed the conſtellation, call it by a name different from both theſe, the Dorado, or golden fiſh; and from this term has been formed the new name Auratus Piſcis.

AURIGA. One of the conſtellations of the northern hemiſphere, and a very conſiderable one; it is one of the forty-eight old aſteriſms, and is mentioned by all the antient aſtronomers. Auriga does not, in proportion to its extent, contain a great number of ſtars, and of thoſe which it has, the greater part are of the ſmaller kind, and have not been ſeen by the old aſtronomers. It is repreſented by the figure of an old man, in a poſture ſomewhat like ſitting, with a goat and her kids in his left hand, and in the right hand a bridle; he has on his head a cap of an odd form, a flowing mantle about his body, and round the lower part of his legs thoſe bands of twiſted ſtraw, which the peaſants and waggoners wear to keep off the dirt. This is his figure in the oldeſt draughts we have of the conſtellations: and this, according to the account of Ptolemy, although he has left no draughts of them, muſt have been that under which the Greeks at this time repreſented it. This is the figure that has been preſerved of it by the aſtronomers of all countries, except the Arabians; and they have not changed it upon choice, but by compulſion. Their religion did not ſuffer them, on any occaſion, to draw the figures of human creatures, ſo they have ſubſtituted a Mule in the place of his figure, with its ſaddle and bridle. This is the more neceſſary to be mentioned, as they have taken ſome ſtars into the bridle of the Mule, whereas there are none, except one ſmall one at the extremity, in the bridle of the Auriga of the Greeks.

The conſtellations, which ſtand round about Auriga, are the Lynx, the Camelopardal, Perſeus, Taurus, and Gemini; and theſe are all ſo cloſe to him, that he ſeems juſt crowded into a ſpace between them. The head of the Lynx is over the head of Auriga, and the fore feet upon his right ſhoulder. The belly of the Camelopardal is over his head, and its hinder feet are oppoſite to his face. The right leg of Perſeus comes in ſo odd a manner behind his left thigh in the figures, that added to the uncouth poſture of Auriga, it ſeems as if the hero had given the waggoner a kick, and removed him from the ground. The right horn of the bull comes cloſe to the right foot of Auriga, and the hand, which holds the dart in Gemini, is oppoſite to his knee. The old aſtronomers allowed fourteen ſtars to the conſtellation of Auriga; ſo many ſtood in the catalogue of Hipparchus, the firſt that was made in Greece, and poſſibly in the world; for we do not find that the Egyptians, although they plainly and immediately arranged the ſtars into conſtellations, ever took an account of the number which themſelves comprehended under the figure. The catalogue of Ptolemy mentions the ſame number fourteen, Tycho ſets down only nine, Hevelius raiſed the number to forty, and Flamſtead has counted ſixty-ſix. Among theſe there is one of the firſt magnitude, a very bright and fine ſtar; it is ſituated on the body of the Goat, which is in his left arm, and is near the inſertion of the ſhoulder of that animal. There are alſo two of the ſecond magnitude, one the bright one in the ſouth foot, and the other the lucid one in the hinder ſhoulder. Theſe three are a very uncommon ſhare of large ſtars for one conſtellation, and they make a conſpicuous figure. Beſide this, there are only two or three of the third magnitude. The generality of the others are ſmall. They are diſpoſed with a tolerable regularity over the figure. There is a cluſter of ſeveral

in the top of the cap, there are two or three conspicuous in the face; the upper part of the body has only small ones, but there are several larger in both arms, and a great many in the robe and on the left leg: the right has fewer.

The Greeks seem to have received this constellation from the Egyptians, and to have retained the bridle as a part of it from the old figure; but they have been perplexed to what story of their history to refer it. As it has been their custom, however, to make these things appear their own, by adapting to each something from their own accounts, they have told us, that this figure of a waggoner was an honourable character. The antients did not much distinguish between wheel carriages, but sometimes call the chariot of the sun Phœbus's Waggon, and even our Shasespear, to keep up the custom, calls Phaeton, a Waggoner, when he tells those fine steads, that such a waggoner as Phaeton would whip ye to the west, and bring on cloudy night immediately. They tells us, that this was Erichthonius, the inventor of coaches.

Vulcan, the fabulists say, fell in love once with Minerva, and when he could not prevail with her to marry him, would have obtained her upon less honourable terms. There was a struggle between them, and some way or other Erichthonius was begotten, though it does not seem that Minerva had much share in it: she took care of the offspring however: some have supposed it was only a serpent, but the graver authors say, Erichthonius was a man with legs only like the body of a serpent, and that to hide this monstrous part of his figure he invented coaches to carry him about. They add, that Jupiter, doing him honour for an invention that was, in some degree, imitating the sun's carriage on the earth, raised him up among the stars.

This is what most of the Greeks say, as to the figure that is called Auriga; and others, who have supposed the constellations to refer to Orsilochus, still make him the inventor of coaches, taking that honour from the heaven-begotten Erichthonius. It is evident, that the Greeks, by their own account, did not make the constellation, for if they had meant it to commemorate only Orsilochus, they would have given him a coach and horses; or if, according to the other, and more received fable among us, they had intended to make a figure of Erichthonius, they would have given his serpent-like legs a place in the drawing. It is evident therefore, that they received this figure, for the disposition of these stars, from elsewhere, and knew no more of it than that it was an human figure. What the Egyptians meant, who first devised it, is lost to us. There are yet other accounts among the Greek writers, and some that answer much better to the figure of the constellation: but that of Erichthonius is the oldest, the rest seem to have been made, from time to time, by men who had a sense of the impropriety of that story to the figure, for that they could not alter for fear of confusing themselves in the accounts of the stars. For instance, if they had extended the legs of the drawing into the serpent length, that would have suited it to their story of Erichthonius, but one of them would have run into the Bull, and the other have confounded itself with the legs of Perseus: and the stars contained in both these figures, would also have got within the out-line of this Auriga, and some would have given them to one, and some to the other constellation. This has been the reason why the Greeks, although the Egyptian figures they had received did not agree well with the stories they affixed to them, yet dared not alter them too far; it

seems

ſeems as if they had indeed added the ſword to Perſeus, becauſe there are no ſtars hardly in it, and there was a vacant place for it in the heavens, where it did not interfere with any other of the conſtellations; but this not being the caſe with the ſituation of Auriga, they continued the figure, though it did not quite agree with their ſtory of its origin.

Others however, ill ſatisfied with a ſtory which ſo badly agreed with the figure, have ſaid that it belonged to Myrtilus, a ſon of Mercury and Clytie, and charioteer to Ænomaus; they ſay, that, at his death, his father Mercury, with the permiſſion of his ſuperiors, raiſed him thus up into the ſkies. All this, however, does not at all account for the goat and her two kids in the hands of Auriga; for certainly theſe animals have nothing to do with the character or buſineſs of a coachman or coach-contriver. To ſet this right, thoſe of ſucceeding times have made Auriga to be Olenus, a ſon of Vulcan, and the father of Æga and Helice, two of the Cretan nymphs that nurſed the infant Jupiter. They talk of a goat that was uſed for giving milk to the young deity, and they ſuppoſe, that this creature, and two young ones, for that is the number it uſually brings forth, were placed in the hands of the father of the virgins, to commemorate the creature they took into their ſervice on that occaſion. This however is all far ſtrained. We know the Greeks aggrandiſed every thing. They raiſed a common female reaper, or worker in the harveſt field, for that is all the Egyptians, from whom they received the conſtellation, meant by Virgo, into a ſort of angel, and in the ſame manner it is probable, that all theſe charioteers and nurſes, of their fable, were applied to the figure, by which the original inventors meant no more than a countryman, or farmer, who was carrying home a goat, and her kids, to take care of them out of the rain or bad weather.

Beſides the Hædi, this conſtellation contains alſo another of thoſe ſtars, which the antients honoured with peculiar names, the goat Capra, and Amalthæa Capra. This is the bright one near the ſhoulder, ſuppoſed to be the mother of the Hædi, and the nurſe of Jupiter. Some have indeed taken away the name of goat and kids, and called this ſtar a ſow, and the two others pigs, aſſerting, according to the teſtimony of Agathocles, that a ſow, and not a goat, did this office to the deity, and producing, in ſupport of it, the divine honours which the Cretans paid to this animal. But we find all the antients almoſt in the ſame ſtory, calling the creature a goat; and indeed we find the ſtory preſerved on medals, for there are extant at this time coins of Valerian, on the reverſe of which is a goat with a child upon its back, and the inſcription Jovi Creſcenti.

The antients in general agreed to give the honour of having been the origin of this conſtellation to the firſt who invented the putting horſes to chariots, but they are divided about who that was. Virgil is expreſs in favour of the fabled race of Vulcan;

Primus Erichthonius curros, et quatuor auſos
Jungere equos rapidiſque rotis inſiſtere victor.

But Scaliger quotes ſome verſes of Corripus to prove, that the invention belonged to Orſilochus. The lines are theſe,

Orſilochum referunt primos junxiſſe quadrigos
Et currus armaſſe novos, Pelopemque ſecundum
In ſoceri veniſſe necem.

But

But if we are to pay any credit to thoſe who pretend to deſerve it, we ſhall, in this paſſage, inſtead of Orſilochum, read Cecropidem, and theſe two will become the ſame perſon.

Though the whole conſtellation of Auriga is not mentioned among thoſe from which the antients formed preſages of the ſucceeding weather, the two ſtars in his arm were of the foremoſt in that rank. It is theſe they called by the name Hædi, and dreaded ſo extremely on account of the ſtorms and tempeſts that ſucceeded their riſing, that they were ſaid to ſhut up the ſea for their ſeaſon. And the day of their influence being over, we find, was celebrated as a feſtival with ſports and games, under the name of Natalis Navigationis. Germanicus calls them unfriendly ſtars to mariners, and Virgil couples them with Arcturus, mentioning their ſetting and its riſing as things of the moſt important preſage. Horace alſo puts them together as the moſt formidable of all the ſtars to thoſe who followed the traffic of the ſea, and when he would deſcribe the tranquility of the man who is content without attempting to accumulate wealth by theſe means, ſays, that the tempeſtuous ſeas, and riſing and ſetting conſtellations of preſage, give him no pain :

Neque
Tumultuoſum ſollicitat mare
Nec ſævus Arcturi cadentis
Impetus aut orientis Hædi.

And to the ſame purpoſe ſpeak all the antient writers, thus making a part of the conſtellation Auriga, if not the whole conſtellation, a thing to be obſerved with the utmoſt attention, and to be feared as much as the blazing Arcturus.

AXIS *of a Cone.* A ſtrait line drawn from the vertex of the cone to the centre of its baſe. *See* CONE.

AXIS *of the Earth.* A line ſuppoſed to be carried through the centre of the globe, and to be that on which it turns round about, continually in the courſe of its revolution round the ſun. The two points of this Axis, where it touches the ſurface, are what are called the two poles of the world.

It is by a revolution of the body of the earth about this Axis, that the return of day and night are made, and the riſing of the ſun and ſtars, and their motions round the earth, are really occaſioned. This was a motion of the earth unknown to the antients in early times, and hence, they accounted for the continual apparent revolution of the heavens round the earth, which they took to be real, and called the firſt motion, by a ſuppoſed impulſive force, communicated from the primum mobile.

The ſun's Axis, and that of the other heavenly bodies, is ſpoken of in the ſame manner with the earth's, and is, in the ſame manner, a line paſſing through their centre, round about which a continual revolution is made ; for this motion of a revolution round their own Axis, ſeems to be univerſal and common to all the heavenly bodies. We perceive it plainly in the planets, by the change of place in their ſpots. In the moon it has been thought wanting, but after-thought has diſcovered, and ſucceeding obſervations proved it. In the ſun, it is plainly ſeen, as in the planets, by the change of place in its ſpots alſo ; and there is great reaſon to ſuppoſe, that it is alſo common to the fixed ſtars, not only as they are of the nature of ſo many ſuns ; but as the appearance of ſome, which after a long time of not appearing, have been called new ſtars, cannot be any way ſo well accounted for, as by ſuppoſing, that they have a ſlow revolution round their Axis ; and that they have parts more obſcure, and parts more bright, on their ſurface, and are only ſeen at the time when the bright part is turned to-

wards us. If it be allowed to these, it will be natural to allow it also to the rest of the fixed stars, and we shall thus find this motion universal.

AXIS *of a Sphere.* The diameter of a sphere, round about which the revolution of that sphere is made, when a motion of rotation is given to it. The two opposite points, or the surface in which this diameter touches the superficies, are called the poles. *See* SPHERE.

AXIS *of the World.* An imaginary line running through the world, from pole to pole. *See* CIRCLE *of the sphere.*

AXIOM. A proposition which is self-evident, or carries proof in itself, without need of reasoning or demonstration. Thus if we say, that equal numbers or quantities added to equal, will produce a sum that will be also equal. If we say, that the sum of all the parts of a thing is equal to the whole; or that if any two quantities are equal to a third quantity, they are also equal to one another; these, and the like self-evident propositions, are called Axioms.

AYUK, *or* AL AYUK. A name by which some have called the bright star toward the shoulder of Auriga. The meaning of the word is a goat, and the star has been called by a name of the same import in almost all the antient languages. It is supposed the mother of the two kids, the Hædi, two bright stars in the arm of the same constellation, and it is called the Amalthæan goat, the nurse of Jupiter.

AZALANGE. A name by which some, who are fond of obscure words, call the constellation Serpentary. It is a barbarous term, and seems only a corruption of Al Hangue, which is one of the Arabic names of this constellation, and signifies the same as Serpentarius.

AZHA AL NAAM. A name by which some, who are very fond of uncommon words, have called the constellation Corona Australis. The term is Arabic, and is one of the names of this constellation. The signification of the words is the Ostrich's Nest; there are two stars in the legs of Sagittary, not very distant from this constellation, which they call Al Naaim, Ostriches, one of which they say is going to water, and the other returning from the water; this neighbouring cluster of stars is the Nest.

AZIMUTHS. A term by which astronomers express certain circles of the sphere, which are called, in others words, verticals, vertical circles, or secondaries to the horizon. For, in the usual acceptation of the astronomical terms, any circles that are drawn thro' the poles of another circle, are called secondary circles to that through whose poles they are drawn. The horizon is a circle, extending to the starry region every way, and having its plane passing through the point of the earth's surface, on which the observer stands, or else through the centre of the earth, parallel to that point. In the first case it is called the sensible, and in the latter the rational horizon; and where the astronomers speak of the horizon without any epithet, they always mean the latter, or the rational horizon; but this to the observer makes no difference; for the whole earth being but a point of no measure, with respect to the sphere of the fixed stars, these two horizons coincide, and make only one line at the heavens, with respect to the observer, upon the globe of the earth; their distance not being perceivable by the

the niceſt obſervations, or the beſt inſtruments.

The horizon then being a great circle, dividing the whole extent of the heavens into two hemiſpheres, and having for its poles the zenith and nadir of the place, that is, the point immediately over the head, and the point immediately under the feet of the obſerver ; whatſoever circles are conceived to be drawn paſſing through theſe two points, or through the two poles of the horizon ; theſe are ſecondary circles to the horizon, and they are called by ſome Verticals, and by others Azimuths.

There may be as many of theſe Azimuths conceived in the plane of the heavens as we pleaſe, and they may be extended, or drawn in and through what part of the heavens we pleaſe : their uſe therefore is obvious ; ſince as all meaſure, reſpecting the heavenly bodies, is made by the degrees of a circle, theſe being circles, and ſo capable of the general diviſion into degrees, ſerve for the immediate meaſuring of any point of the heavens, or of any phænomenon occupying any point of the heavens, with reſpect to its height above the horizon. Thus, if a ſtar be required to be deſcribed with reſpect to its altitude above the horizon, the thing is to be done by means of an Azimuth. We are to conceive a circle paſſing through the zenith and nadir of the place of obſervation ; this is an Azimuth, or a ſecondary circle of the horizon, becauſe it paſſes through the poles of the horizon. We know that the ſtar muſt be between the horizon and the zenith. If it be any where viſible, it muſt be between theſe, and the diſtance from the horizon to the zenith being only ninety degrees, a part of theſe muſt make its height. All that is neceſſary to do this, is, to take the height of a ſtar by a quadrant, and meaſuring the arc of the circle intercepted between its place in the heavens and the horizon, the number of degrees of which that arc conſiſts, are the meaſure of the ſtar's altitude. This is the manner in which the ſun's altitude is taken in obſervations, and by this may be ſeen the great uſe of theſe Azimuths. When it is requiſite to be very preciſe, inſtead of the ordinary plain ſights, through which the ſtar is to be viewed on the inſtrument, which are only a couple of holes pierced thro' plates of braſs, they put on a teleſcope, and, drawing a couple of hairs over the eye-glaſs, ſo that they croſs one another at its centre, this place of the ſtar is to be taken when it is ſeen at the interſection of thoſe hairs, and then the exactneſs is greater. When yet more accuracy is required, they uſe an inſtrument, which, being a ſmaller part of a circle, may be divided more accurately at the limb. They take a ſixth, or only an eighth of a circle on this occaſion, and call the inſtrument a ſextant, or an octant ; and thus being rid of the encumbrance of any unneceſſary quantity, they divide the ſpace they retain into more minute meaſures. For, taking the ſun's altitude in the uſual way, there is no more neceſſary than the letting it ſhine through one of the ſights, and turning the inſtrument about till the ſpot of light falls upon the centre of the other hole : and when more accuracy is required, and teleſcopic ſights are made uſe of, it is cuſtomary to receive the ſun's image from the teleſcope upon a piece of white paper, held in ſuch a poſition that the rays may fall perpendicularly upon it. By this means a luminous circle is formed upon the paper, and the croſs hairs, which are drawn over the eye-glaſs, are ſeen upon it ; when the croſſing of theſe is exactly at the centre of this bright circle, all is right, and the height of the ſun is to be meaſured from that point.

If it be ſuppoſed, that even this is not a ſufficient degree of accuracy, for there are ſome occaſions on which, in the taking the ſun's altitude, no accuracy can be too great, the method is, for two perſons, at the ſame moment to make the obſervation, the one meaſuring from the upper edge of the ſun's image, and the other from the lower; then taking the middle between theſe, we have the place of the centre. All this care is ſometimes neceſſary with reſpect to the ſun's height, becauſe being of a conſiderable diameter, it is only with reſpect to his centre that we can ſpeak with preciſion; but this is not the caſe with reſpect to the fixed ſtars, for the very largeſt of theſe having no viſible diameter according to ſome aſtronomers, and according to thoſe who allow moſt, only a diameter of a few ſeconds, nothing of this kind is neceſſary: their whole magnitude being, with reſpect to us, a point, or ſomething ſo very near a point, that the meaſure is quite unimportant.

There is another way alſo of adding to the preciſion in the meaſure of the altitudes of the ſun and ſtars by theſe Azimuths, which is by taking an inſtrument of ſmall quantity; by this, not meant of ſmall bulk, but of a ſmall portion of the circle; ſo that it may be divided into more accurate and minute meaſures on the limb; ſome uſe a whole circle for this purpoſe, hanging it up in ſuch a manner that it is vertical to the horizon, and has a diameter, expreſſing the horizon drawn acroſs it. Others take only the half of a circle; and others only a quarter. This laſt is the moſt uſual, and is all that can be neceſſary, ſeeing that the whole diſtance from the horizon to the zenith being only ninety degrees, more than ninety degrees cannot be requiſite to any admeaſurement. The quadrant, or quarter of a circle, containing ninety degrees, is all therefore that can be neceſſary; and conſequently it ſerves all purpoſes. But though more parts of a circle than ninety degrees cannot be neceſſary for any obſervation, fewer may do for a great many. And it is on this principle that the greater accuracy of diviſion of the inſtrument is eſtabliſhed. For theſe purpoſes they make an inſtrument which is of as large bulk as can conveniently be uſed, and yet which is leſs, as a part of a circle, than a quadrant: they make it only a ſixth or an eighth part of a circle, as obſerved, and they call it, inſtead of a quadrant, a ſextant, or an octant. This being of a larger meaſure, in proportion to the number of degrees marked on its lines, has the degrees divided into ſmaller parts, and conſequently gives the meaſure the more accurately; with this, as with the others, the altitude of the ſun, or of a ſtar, is meaſured by means of one of the Azimuths, or ſecondary circles, to the horizon; and thus all the altitudes of the heavenly bodies are taken. The number of theſe Azimuths is as great as we pleaſe, and one of them may be at any time conceived for the uſe, whereſoever a ſtar, or any other heavenly body is, whoſe altitude is to be taken. Together with theſe Azimuths, we frequently meet with the mention of Almicantarahs. Theſe are circles parallel with the horizon, as the Azimuths are vertical to it, and theſe have been deſcribed already under their proper head.

AZIZUS. A name by which we find thoſe, who love uncommon terms, call the planet Mars. It is an oriental word, and ſignifies ſtrong and powerful.

AZUR. A name by which ſome of the aſtronomical writers have called the planet Mars.

Mars. It has appeared a ſingular one to ſome who connect the idea of blue to azure, becauſe this word is uſed in ſome languages to expreſs that colour, which is ſo very different from that of the planet. It is indeed from the peculiar colour of this planet in the heavens, that it has been named Azur, but this is a Perſian word, and in that language ſignifies fire. It has been given to the planet, to expreſs its ruddy, or fiery colour in the heavens, as the Greeks call him Pyrois for the ſame reaſon.

B.

BAAL SCHEMAIM. A name by which some, who affect to use uncommon terms, call the sun; it is a Phœnician name of that luminary, and signifies principal in the heavens.

BAALATH. A name by which some have called the constellation Cepheus; it is only a part of the Hebrew name of that constellation; it is called, in that language, Baalath Halab, the signification of which is Domina Flammæ, the Mistress of Flame, so that they made it female.

BADAD. A name by which some, who are fond of uncommon words, call the sun; it is one of the Syriac names of that luminary, and signifies alone.

BADIYA. A name by which some, who are fond of uncommon names, have called the constellation Crater; it is its Persian name, and in that language signifies a great calf.

BAGIR. A name by which some, who are fond of unusual words, call the constellation Cygnus; it is the Turkish name of the sign, and signifies a bird in general.

BALICK. A name by which some, who are fond of uncommon words, call the constellation Pisces; it is the Turkish name of that sign, and signifies fish.

BALTHEUS. A name given by several of the Latin authors to the zodiac.

BARRELL OF MEAL. According to the enthusiasts, who have taken upon them to reform the sphere, a name of one of the southern constellations. It is the Southern Fish that they call by this name, having arranged the stars, by others comprised under the out-lines of that figure, under those of this scripture utensil. They are not however agreed about this. This is Schiller's innovation, but Skiccard makes it the fish taken up by Peter with the penny.

BARTHOLOMEW, *or* ST. BARTHOLOMEW. A name which some enthusiastic writers have given to one of the signs of the zodiac. Schiller is at the head of these fantastic innovators, and is the man who proposed displacing the Ram, the Bull, and the rest of the twelve figures of the zodiac, to make way for the more Christian astronomy of the twelve Apostles. He has placed St. Peter for Aries, St. Andrew for the Bull, and so of the rest. St. Bartholomew represents what in other writers is the Scorpion. Few have paid any attention to this, and indeed the mischief that would attend it is too obvious. We must lose the advantage of all the early observations, for they refer to the stars as occupying parts of the old figures. *See* SCORPIO.

BASA-

BASANISMOS. A name by which ſome, who love hard words, have called the conſtellation Aquila, the Eagle; it is one of its old Greek names; they called it alſo Baſanos.

BASANISTERION. A name by which ſome, who love hard words, call the conſtellation Aquila; it is one of the old names of that conſtellation.

BASANOS. A name by which ſome, who are fond of odd words, call the conſtellation Aquila; it is one of the old Greek names of that conſtellation; they call it alſo Baſaniſmos.

BASILISCUS. A name given by ſome of the old aſtronomers to a large ſtar in the breaſt of Leo, called alſo by ſome Cor Leonis, the lion's heart. It was not unuſual with the Greeks to call ſingle ſtars, which they ſhould have frequent occaſion to mention, and which were very conſpicuous, by peculiar names. The Arabians alſo have followed them in this. Their Fomehaut and Aldebaran are not quite ſo well ſounding words as the Pleiades and Hyades, but they ſerve the ſame good purpoſe of aſſiſting us to talk with the greater accuracy and eaſe of the ſtars.

BATHESHEBA. A name given by ſome of the aſtronomers to Caſſiopeia. Hartſdorf is the author who firſt gave it. Schiller goes to the New Teſtament for a name of the ſame conſtellation, and calls it St. Mary Magdalen. *See the account of it under the word* CASSIOPEIA.

BATHILLUS. A name by which ſome, who are fond of uncommon words, have called the conſtellation Ara, the altar. It is one of its old names among the Latin writers.

BATIGNON. A name by which ſome have called the conſtellation Eridanus. It is a Tuſcan name for the conſtellation, and is ſometimes ſpelt Botinion.

BATIGA. A name by which ſome have called the conſtellation Crater. It is one of thoſe uncouth terms which thoſe have introduced into the ſcience, who thought there was a merit in writing obſcurely. It is the Perſian name, and ſignifies a great cup.

BEAR. A name given by the antients, and continued to this time, to two of the conſtellations near the north pole, the one is called the Great, and the other the Leſſer Bear; they will be hereafter deſcribed at large, under the names of Urſa Major and Urſa Minor

BEARD *of a Comet.* A name given to the tail of a comet, or to that portion of its vapours which is enlightned by the ſun, and which appears ſhort, and on the anterior, inſtead of being long, and on the poſterior part of the comet. The thing is the ſame, whether in form of a tail or beard, or of hair all round it; it is only different according to the ſituation of the ſun, the earth, and the comet.

BEE, APIS. One of the new conſtellations of the ſouthern hemiſphere, ſituated between the hinder feet of the Centaur, and the head of the Chamelion, and containing only four ſtars. It is one of the ſmalleſt conſtellations in the heavens. *See the article* APIS.

BELOCRATOR. A name by which ſome of the old writers have called the conſtellation Sagittary. It is the name by which many of the old Greeks called it.

BENE-

BENEDICT, or *St. Benedict among the Thorns.* A name given by Schiller to a conſtellation of the northern hemiſphere, which he has formed by new modelling that of Ophiucus, or Serpentary. He has placed ſome fuze-buſhes in the ſtead of the Serpent, and the human figure he calls Benedict.

BENOT. A name by which ſome, who are fond of uncommon words, call the planet Venus. It is the uſual, though not the only Hebrew name of this planet; and it is very poſſible, that the word Venus may be derived from it; the B, being ſoftned into an V, in the ſpeaking, and the Hebrew termination reduced into one more natural to the other languages.

BERENICE's HAIR. One of the conſtellations of the northern hemiſphere placed behind the tail of the Lion; and containing, according to Hevelius, twenty-one, and according to Flamſtead, forty-three ſtars. It is not of ſo late date as the new conſtellations of Hevelius, nor is it ſo old as the forty-eight, of which we read in Ptolemy. Conon formed this out of the Stellæ Informes, or unformed ſtars of the Lion, in commemoration of a lock of hair which Berenice, the queen of Ptolemy Euergetes, dedicated in a temple of Venus, on account of a victory of her huſband. The lock by ſome accident was loſt out of the temple, but Conon perpetuated it in the heavens. *See* COMA BERENICES.

BERRI. A name by which ſome writers have expreſſed the conſtellation Aries, or the Ram; the firſt ſign of the zodiac. Berri, or Bere, is the Perſian name of the conſtellation.

BERSANU NICBESTE. A name by which ſome, who write that they may not be underſtood, have called the conſtellation Hercules. It is a Perſian name, and ſignifies a man kneeling.

BERSHAUSH. A name by which ſome call the conſtellation Perſeus. It is one of the Arabic names of that conſtellation, and poſſibly was only their way of writing Perſeus.

BETHULA. A name by which ſome fanciful writers have called the conſtellation Virgo; it is the Hebrew name of the ſign, but it is idle to uſe it inſtead of the received one.

BETHULTO. A name by which ſome have called the conſtellation Virgo; it is the Syriac name.

BIRD OF PARADISE. One of the new conſtellations, extending from one of the corners of the ſouthern triangle to the tail of the Camelion, and containing eleven ſtars. It is alſo called Avis Indica, and Apus, and Avis Paradiſiaca. *See the article* APUS.

BITCH. An Arabian conſtellation, anſwering to our Caſſiopeia. The Arabians were not permitted by their law to draw any human figures, and they therefore retained the chair in this conſtellation, but diſplacing the lady they put this quadrupe in her ſtead.

BLAZING STAR. A name by which the vulgar call a comet; and according to the different ſituations and appearances they annex to it the title of a bearded, a tailed, or an hairy blazing ſtar. It is not a wonder, that ſuch appearances as theſe ſhould be looked on as portents, and ſuppoſed ominous. Their novelty in the heavens could not but attract the eye, and the train of light they carried after, before, or round about them, ſo different from

from all other things seen in the heavens, must add vastly to the surprize. Indeed it is but of very late years that we have been able to take off the wonder by accounting for their appearance.

Among the antient astronomers, some had supposed them only illuminated vapours, or a kind of meteors; nor have there been wanting some of the moderns to support such an opinion. Others have supposed them congeries of little stars, which being too small to be seen singly, yet, when they met by accident together, were visible in the cluster, and continued so till they, by degrees, separated again; and others have imagined them of the nature of the planets, but out of our system, and so only visible to us in some small part of their orbit, in which they approached nearest to it. But all this is error.

Blazing stars, as they are called, or, in the more proper term, comets, are no other than planets of a peculiar rank: they are globes of compact and firm matter, which revolve round about our sun, and are a part of our system. They are naturally cold and dark as the planets, but they, at times, approach so near the sun, as to be made red hot; and this in a degree that will make them require many thousands of years in cooling: the heat which they acquire being intense to a degree two thousand times as great as that of red hot iron. The reason of the variety of situations, in which they are, with respect to the sun, is, that they perform their revolutions about that luminary in ellipses as the planets do, but then the ellipses of the planets are short, and approach to the figure of circles; whereas these of the comets are vastly long and excentric. The consequence is, that the comet is only seen in a small part of its revolution by us who inhabit this earth, and is at that time in a situation, with respect to the sun, vastly different from that in which it is at other times. As it approaches the sun, it becomes hot; when 'tis nearest to him it acquires this extreme degree of heat that has been mentioned, and as it departs from him, it cools again a little as it goes into its long escape. We see the comet only while it is thus near to the sun, and at this time the vapours which have been exhaled from it by this heat, being shone upon by the sun, make this tail.

Among those, who have been much better acquainted with the nature of comets than the antients, there have been some who would allow nothing on the subject of their revolution; but have supposed, that they only appeared to us in their fall through the boundless air, and that their appearance was a work of chance, and those which had been seen never would be seen again: but this is all error, for the periods of three or four of them are known, and the times of their several appearances calculated. The famous one that was seen at the death of Julius Cæsar has been known to be the same with that which was seen again in the year 531, a third since in 1106, and a fourth in 1681. This therefore performs its revolution in 575 years, and two others have been found to be regular; the one having a revolution of an hundred and seventy-nine years, the other only of seventy-five years. This last mentioned is that seen in 1682, and it will be seen again, if the calculations hold good, in about four years. This, however, is one of the least of the known comets, for as the smallest planets are those which perform their revolutions nearest to the sun, it is to be judged, that those of the comets, whose revolutions are shortest, and whose approaches to the sun are most near, are also the smallest.

It is probable that these do, at one time or other, fall into the sun, and serve as a supply for the waste; for although the particles of

light

light are inconceivably small, yet the quantity of them, emitted from the sun, is so very great, that there would be some diminution of the sun's bigness, were there not some supply.

Thus we see that the comets, although they are not, as superstitious people have believed, the immediate denunciations of vengeance from heaven; yet they have their use in the œconomy of the universe: nor is this all the use. The vapours which are raised from them in their passage by the sun, and are lost in the air, are, by degrees, and in consequence of their own gravity, received into the atmosphere of one or other of the planets. We are not to suppose that this becomes a load upon the planets, or that the Creator of the universe did not provide for its being of use to them; far from encumbering, it is necessary to them. We find, by observing the operations of nature, that there is a continual decrease of the fluid on our globe, and so it doubtless is on the rest. The vegetables are solids made from water principally, and when they putrify they produce earth, earth being always precipitated to the bottom of putrifying liquors. Thus the solids of these globes would encrease, and the fluids diminish, if there were not a supply of fluids from these vapours of the comets.

BLEPSYS. A term by which the later Greek writers have expressed what the earlier called Schematisms and Syzygys, and what the Latins called Conspectus. It is what the astrologers of our time mean by the term Aspect. When a planet, and a fixed star, which they chuse, or a constellation, to which they suppose it has some affinity, are in conjunction, in opposition, or in a sextile trine, or quadrate distance, that is at sixty, ninety, or an hundred and twenty degrees distance, they were supposed to have a mutual radiation, and to cooperate together. From this comes all the jargon of Aspects, and all the pretensions of astrologers, to predict future events, stand on such foundations.

BODY *of a Comet*. The whole of a Comet except its tail. Some, instead of this term, call it the head of the Comet, by way of distinction from the tail, but this is less expressive, and some call it the Nucleus, but this is still more liable to confusion, as some in speaking of the body of the Comet, as seen with the telescope, have distinguished, by the name of Nucleus, its centre, or central part.

BOOTES. One of the constellations of the northern hemisphere, and a considerable one; it is one of the forty-eight old constellations, and has a considerable extent toward the north pole. The quantity of stars is not however so great as in some others, in proportion to the size. Bootes is represented as a man in a posture of walking; he has no covering upon his head; in his right hand he holds a club, and the other is extended upwards, and has hold of the cord of the two Dogs which seem barking at the Great Bear. The constellations about Bootes are the Great Bear and Dogs, the Berenice's Hair, the Serpent, the Northern Crown, and Hercules. The Serpent faces him, its head reaching up as high as to his right knee, the Northern Crown is just by his club, Hercules is above him, one of his feet comes near his head, and just by the top of his club; the Dogs are at his left side, with the Great Bear before him, and Berenice's Hair is near his left leg, or at a little more distance from that, than the Serpent from the right.

The antients counted twenty-three stars in Bootes. Ptolemy allows so many in his catalogue; Tycho allows but eighteen; Bayer makes them thirty-four, Hevelius fifty-two, and

and Flamstead fifty-four, of all these there is not one, of either the first or second magnitude, within the out-line of the figure, but between the legs, or a little above the left knee, is a very bright and fine one of the first magnitude, called by the Greeks Arcturus.* The others are scattered but thinly over his body; there are three in the left hand, several on the club, and some considerable ones on each leg.

The Greeks do not give any certain account of the origin of this constellation. Those who of very early days made the stars, which afterwards were formed into the Great Bear, represent a waggon drawn by oxen, made this Bootes the driver of them: others continued the office when the waggon was destroyed, and made a celestial bearward of Bootes, making it his office to drive the two Bears round about the pole, and some, when the greater waggon was turned into the Greater Bear, were still for preserving the form of that machine in those stars which constitute Bootes.

The antiens have had other opinions also as to this constellation. They have manifestly, in some places, called it Icarus, and have gone so far as to make the Great Bear, or great wain, dependant on, or formed from it, calling the three stars which we place in the tail of the Bear, and which they called the beasts that drew the waggon, by the express name of Icarus's oxen. We find Propertius saying,

Flectunt Icarii sidera tardi boves.

This constellation has been treated like the others by those enthusiasts, who some time ago were for new naming, or new modelling, all the constellations. Schiller calls it St. Jerom, for he admits none but saints into these starry seats; but Hartsdorf, who now and then picks up a patriarch, calls it Jacob.

BORYSTHENES, *Climate of.* A name given by the antients to what they call their sixth climate, or to the sixth division north of the equator. As they had not our division by degrees and minutes of latitude, they distributed the surface of the globe, so far as they were acquainted with it, into climates. They began at some distance north of the equator, when the longest day was twelve hours and three quarters; this was the beginning of their first climate, and from this they counted seven. Each climate comprised the extent that was between two parallels, the longest day at the one of which was half an hour different from the longest day of the other, and they called each of these climates by some name taken from a place of note, which was in or near the middle. The parallel, which had the day a quarter of an hour longer than at one of the extremities of this climate, and a quarter of an hour shorter than at the other, was supposed to pass over the mouth of the Borysthenes, and consequently they called this their sixth climate, after the name of that river.

BUFO. A constellation offered to the astronomical world, and composed of a number of unformed stars near the sign Libra.

The animal, under the out-lines of whose figure these are arranged, is the common toad, mentioned by all the writers on natural history, and celebrated among the vulgar, to a proverb, for the brightness of its eyes, one of which is represented by the most considerable star in the constellation.

It is but a small asterism, but for the space which it occupies in the heavens, it contains a very fair portion of stars; these have always been considered as a conspicuous cluster, and it is wonderful that they have not before been arranged under the form of some animal, in the manner of those clusters which form the Lynx, and the others.

The conſtellations, between and among which the Toad is placed, are Libra, the tail of the Hydra, the Centaur, and Wolf, and the Scorpion. Its head is toward the Scorpion; and its rump toward the tail of the Serpent. One of the claws of the Scorpion comes very near to the front of the Toad's head, and the lower part of the under ſcale in Libra, is as near to the upper part, or crown of its head: one of the feet of Virgo is over its back, but this is at ſome diſtance; the bright ſtar in the tail of the Hydra comes very near the hinder part, and the belly and feet are over the Wolf and the Centaur.

The conſpicuous ſtars in the conſtellation Bufo are fifteen, and ſome of them are remarkably bright and conſiderable; in the head there are only two, one is near the extremity or mouth, and this a ſmall one; the other, which may be called the Toad's Eye, is a very fine one of the ſecond magnitude. There are two on the upper part of the neck, and two more in the fore paw. Upon the anterior part of the body there ſtand ſeven, they are of different magnitudes, but two toward the back are large, and one at the ſide, toward the thigh of the fore leg, is yet larger. There is alſo a large one in the hinder thigh, and another in the rump, or at the hinder extremity of the body. There is not any one of theſe that is very near any of the other conſtellations, but they are abſolutely a detached cluſter.

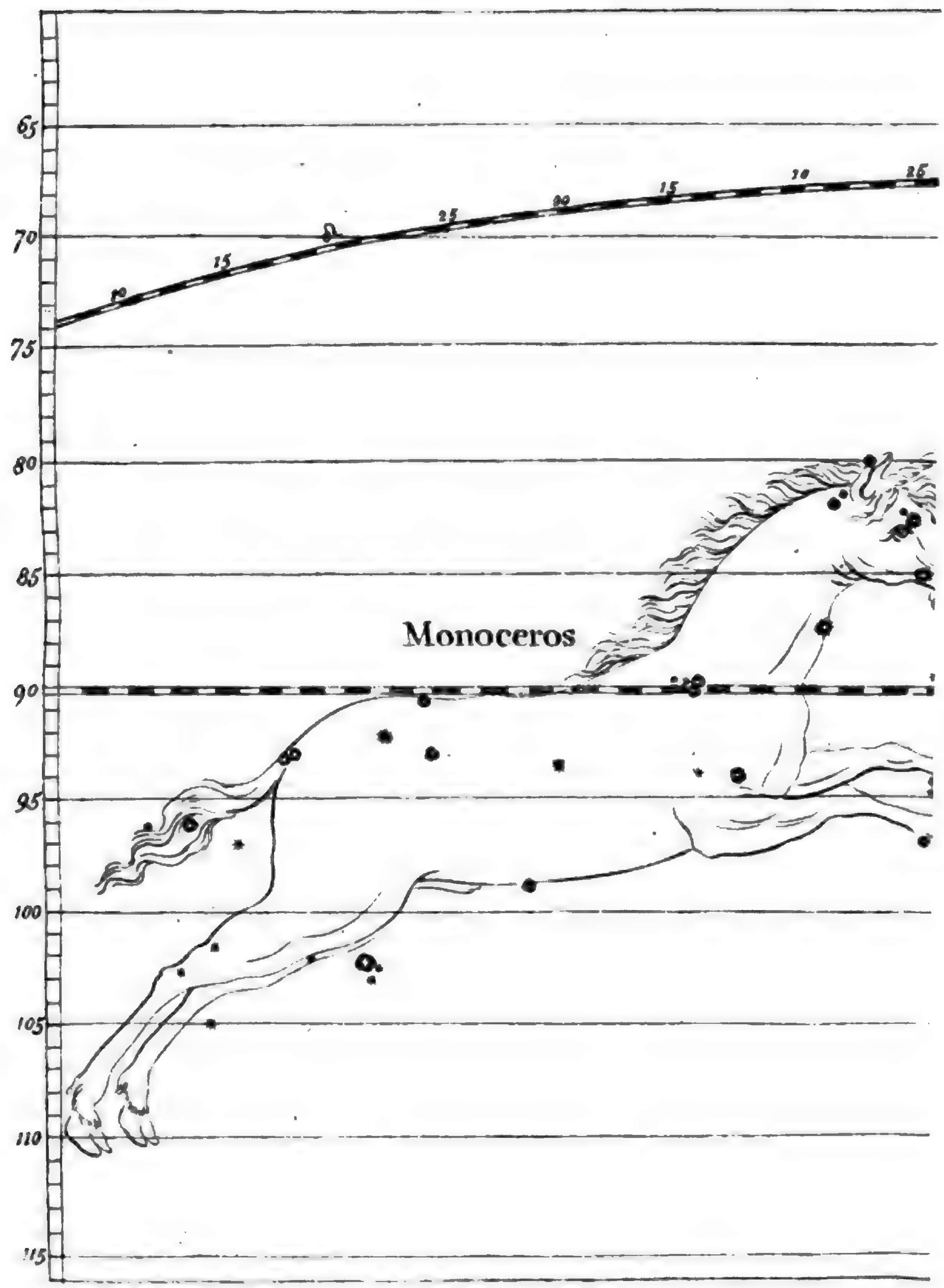
BULL, *Taurus*. One of the conſtellations of the northern hemiſphere, and a very conſiderable one on many occaſions. It is mentioned by all the writers on aſtronomy, and is one of the forty-eight old conſtellations, and one of the twelve ſigns of the zodiac, giving name to a twelfth part, or diviſion, of the ecliptic. There has been always judged ſufficient reaſon to imagine, that what are called the forty-eight old conſtellations of the Greeks, were the original invention of the Egyptians; or, if their real origin were to be traced yet higher, that it was from the Egyptians however that the Greeks received them. But with whatever degree of probability this may be received, as the caſe with reſpect to the generality of the conſtellations, there is almoſt a certainty that it was ſo with regard to the twelve ſigns of the zodiac, whatever fables the Greeks may have ſince deviſed to aſſign the invention of them to their own country.

Taurus is not a conſtellation of the greateſt extent, Pegaſus and ſome others are larger, but it contains a great quantity of ſtars within its out-line, and thoſe are many of them ſo conſiderable, and the greater part of them ſo well placed, that it is not eaſy to name a conſtellation that is ſo very conſpicuous, or ſo eaſily determined.

We are not to underſtand by the word Taurus, that thoſe, who formed the conſtellation under its name, gave the whole figure of a bull for containing the ſeveral ſtars. The figure, as it ſtands in all the ſchemes of the heavens, from the earlieſt to the lateſt, is only that of the fore part of the animal. It repreſents the head, neck, ſhoulders, and fore legs of a bull, with a ſmall part of the back; it is cut off there, and the tail of Aries is in the place of the top of its ſide near the ſhoulder.

The conſtellations, among and between which Taurus ſtands, are Orion, Auriga, Perſeus, Aries, the Whale, and Eridanus. Orion is placed full in front of him, but lower, and ſeems aiming a blow at him with his club, the top of the club coming very near to the right horn. Auriga is juſt over his head, the tip of his left horn touching the right foot of that conſtellation, ſo that the bright ſtar at the tip of that horn may as well be ſaid to be in the foot of the other conſtellation be-

tween


Monoceros
65
70
75
80
85
90
95
100
105
110
115

tween Orion and the feet of Auriga, but at a greater distance. On the ecliptic stand Gemini. The foot of Perseus comes down almost to touch the back of the Bull. The tail of Aries, as already observed, is at the section of the body toward the shoulder. The head of the Whale comes near to the left foot of the Bull, and a part of one of the curves of the river Eridanus, is under his feet at a small distance. We often see a small constellation placed in a large space made between four or five others, as is the case, for instance, with the Triangle between the head of Aries, Perseus, and Andromeda; but this is not the case with Taurus; 'tis a tolerably large space that is left between the constellations just named, and the figure occupies almost the whole of it.

Many of the drawings, in the schemes of the heavens, are very unlike to the animals they are meant to represent, and the creatures of the skies have been accused of being no more like their names-sake on the earth, than those of our heralds; but this is not the case with Taurus. The Serpent of the heavens may have a fine head of hair, and the Bear may be furnished with a tail like a lion, but the Bull is, upon the whole, a very good figure; all that is amiss, is, that the horns are too long for that creature: but there is an excellent good excuse, two very considerable stars are disposed in the two tips of them, and it was better to make a little free with the out-line, than to have omitted them in the constellation. It may be said, the head might have been drawn forwarder, but there are two other stars that would then have been as much out of the characteristical place they possess at present.

The antients counted forty-four stars in the constellation Taurus. Ptolemy has given it so many, and we know he followed the account of Hipparchus, who published the first catalogue that ever was made of the fixed stars of the whole hemisphere, at least it is the earliest we hear of, and by the manner in which the writers of the succeeding ages speak of it, it seems as if that was its true character: they name it as a thing before unattempted, and call it an undertaking for a god. Tycho Brahe makes very near the same accounts of the stars in Taurus, that Ptolemy, and the older Hipparchus had; he makes them forty-three. Hevelius has added to them considerably; he sets them down at fifty-one; but our Flamstead has swelled the account much higher, he makes them an hundred and forty-one.

Of these there is only one of the first magnitude, this is the star in the southern eye of the Bull, and is called by a peculiar name Aldebaran. There is also one, and only one, of the second magnitude, this is that at the tip of the north horn. There are four or five of the third magnitude, and many of the others are considerable enough to be conspicuous. Beside these single stars also, which are thus worthy notice, and have had peculiar denominations, there are two little clusters within the lines of this figure, which have been distinguished by the Greeks, and from them by all the succeeding astronomers, with peculiar names, as if they were separate constellations. These are the famous cluster in the neck toward the shoulder called the Pleiades, and the cluster in the face called the Hyades.

The rest of the stars are very equally distributed over the figure; there are several pretty considerable unformed ones between and about the horns, and there are some in them. Beside the cluster already mentioned in the face, and the others particularised here, there are several stars in different parts of it: the fore legs have each three or four considerable stars, beside several smaller; and scarce any part of the body is wholly without them. There are two bright

ſtars in the fartheſt part of the ſection about oppoſite to the middle part of the head of the Bull, in their direction, that might very naturally be added on this occaſion to the number of thoſe in the body, but they are the two bright ones in the tail of the Ram, and only approach the limits of this conſtellation, they are not a part of it. Upon the whole, however, the bull is as conſpicuous a conſtellation as any in the heavens.

The Greeks, who, by their own confeſſion, received the rudiments of their aſtronomy from the Egyptians; who began only to be acquainted with it at the time when Thales (for he was the firſt that did ſo) travelled into Egypt for the improvement of his ſtudies, yet are ambitious of being thought the authors and inventors of this ſcience. There is nothing puts in ſo ſtrong a claim to the diſcovery of any ſcience, as the having its original deſigns among thoſe who pretend to it; on this conſideration the Greeks, although conſcious that they had received from the Egyptians the ſigns of the zodiac, and perhaps all the forty-eight old conſtellations, that is all they were acquainted with, yet have affixed to every one of them ſome part of their own hiſtory, to blind the world, and make them ſeem the invention of their own people.

They tell us, that this conſtellation is the famous Bull, which is recorded in their ſtories to have carried Europa ſafe acroſs the ſeas to Crete, and that Jupiter, in reward for ſo ſignal a ſervice, placed the creature, whoſe form he had aſſumed on that occaſion, among the ſtars, and that this is the conſtellation formed of it. It would have been well for the Greeks if they could have kept in one ſtory on theſe occaſions; but the multiplicity of their accounts of the ſame thing, and the variety of the fables they bring in as the origin of the conſtellations, this, as well as the reſt, deſtroy the credit of one another.

While ſome of their writers give this account of the Bull in the zodiac, others, at one ſtroke, transform it into a Cow, and give quite another hiſtory of its origin. They tell us, that when Jupiter had transformed Iō into a Cow, he took her up into the ſkies, and made this conſtellation.

Theſe are not the only ſtories of the origin of this conſtellation, but it is not among the Greeks that we are to look for what truly is ſo. They received the figure from among a people of a very different turn and temper, and as they never knew any thing of the occaſion why it was given to the ſtars that are arranged under it, it is not to be expected they could give any. As fond as the Greeks were of their fable, ſo fond were at all times the Egyptians of their hieroglyphics, and we need not doubt, but in the diviſion of the heavens, under the forms of animals, they adhered to their old cuſtom; and that having their choice of all the animals in the creation for any part of the ſphere, as the out-lines of one would contain the ſtars they had to deſcribe, as well as thoſe of another, they doubtleſs, in theſe caſes, choſe ſuch as ſhould convey ſome meaning, appropriated to the part of the heavens in which they were placed. Let us examine them in this light, and we ſhall not be diſappointed.

The care of flocks and herds was one part, and a great part of the buſineſs of the firſt people, and they were to watch their encreaſe. The principal animals they cheriſhed were the ſheep, the ox, and the goat, and ſpring was the ſeaſon of the year when theſe brought forth their young, or if brought forth ſooner, when they led them out into paſtures, and they began to get ſtrength. The ſheep is the earlieſt of theſe, the cow the next,

and

and the goat lateſt. The ſpring-ſeaſon was to be divided into three portions, and theſe were to be marked by the entrance of the ſun into a certain part of the heavens. This part of the heavens was to be determined by the ſtars which occupied its ſpace, and theſe were to be aſcertained to the obſerver, by placing them within the out-lines of ſome imaginary figure, the repreſentation of ſome animal; in this caſe, what was ſo natural for them to chuſe, who were to mark out by this means, the ſucceſſive production and growth of lambs, and calves, and kids, as thoſe very animals, or the parents of them. They did thus: and Aries, or a Ram, Taurus a Bull, and Gemini a pair of Kids, for that was the original figure, were employed to mark out the three ſucceeding months of the ſpring; that when the huſbandman ſaw the ſun in the Ram, he might be reminded this was the time for his lambs, when in the Bull for his Calves, and when in Gemini for his Kids. The reaſon why the pair of Kids was put in the account, and not a ſingle animal of that ſpecies, was, that the Goat uſually brings forth two at a time, the Sheep and Cow only one. The Greeks have not perverted any of the ſigns ſo much as Gemini. They knew nothing of the meaning of the Egyptians, who deviſed the conſtellation, and they changed the two young Goats into two human figures, and gave them the names of two of the heroes of their fabulous hiſtory. Nothing can be ſo ridiculous as the account we receive from the Greeks of the transformations, and raiſing up of people, and of animals into the heavens, to make the conſtellations; nothing is ſo ſimple and familiar as this ſyſtem of the Egyptian deſign; and what is ſimple and natural is uſually true.

BUZEGHALL. A name by which ſome, who are fond of uncommon words, have called the conſtellation Capricorn. It is the Turkiſh name of that ſign, and ſignifies in that language a kid.

C.

CADUCEUS. A name by which ſome have called the conſtellation, more univerſally known by the name of Corona Auſtralis, or the Southern Crown.

CALLISTO. A name by which ſome of the old aſtronomers, or authors, who have alluded to aſtronomers, have called the conſtellation Urſa Major, or the Great Bear, from an opinion that it had its origin, from an Arcadian nymph of that name, firſt turned into a bear, and then carried up to heaven. *See an account of the conſtellation under the name* URSA MAJOR.

CALPE. A name by which ſome, who are fond of uncommon words, have called the conſtellation Crater. It is no new whim to call it thus, for we find the name in ſome old writers.

CAMARUS. A name by which ſome of the old aſtronomical writers call the ſign Cancer.

CAMEL. One of the Arabian conſtellations; it ſtands in the place of the Hercules, or Engonaſin of the Greeks. The Arabians were forbidden by their law to draw any human figure, ſo they have placed a Camel capariſoned, and in the poſture of kneeling, to receive his load, in the place of Hercules.

CAMELOPARDALIS, *the Camelopardal.* One of the new conſtellations of the northern hemiſphere; we are not to expect the name of it among the old writers; for it is one of thoſe which Hevelius has added to the original forty-eight, and made out of the unformed ſtars, about one or other of the antient aſteriſms.

The Camelopardal is a conſiderably large conſtellation, and contains a quantity of ſtars, proportioned to the ſpace which it occupies in the heavens, but they are many of them ſmall. It is the figure of a very ſtrange animal of Africa, and is not ill deſigned upon the globes, and in the ſchemes of the heavens. It is a very long-necked creature, and its limbs are ſmall. It is repreſented in a poſture of walking, one of the fore feet advanced, and the three others kept on the ground, the head ſmall, and on it are a pair of ſhort horns.

The conſtellations, between and among which the Camelopardal is placed, are Perſeus, Caſſiopeia, Cepheus, Urſa Major, Lynx, and Auriga. Perſeus is placed behind it. The hinder legs of the creature come to his knee. The feet of Caſſiopeia are over its rump, but at ſome diſtance. The feet of Cepheus are almoſt directly over its head, and one of them at a ſmall diſtance. The head of the Great Bear comes very near that of the Camelopardal; they ſeem walking, as it were, to meet one another. The head of the Lynx comes to the knee

knee of the fore foot which is raiſed, and the hinder feet are very near the head of Auriga. The ſpace left between theſe conſtellations is very conſiderable, the new one of the Camelopardal does, but in part, fill it, but it does this very happily, and in the ſpace over its back, and between that and the feet of Caſſiopeia, there are very few ſtars, any thing conſiderable for their ſize.

The Camelopardal, according to the account of Hevelius, who was the inventor of it, contains only thirty-two ſtars; but the diſcerning Flamſtead has encreaſed the number to fifty-eight. Of theſe, however, there is not one of any of the conſiderable magnitudes, and for the reſt, they are not diſpoſed ſo happily, according to the out-lines of the figure, as they are in ſome other of the conſtellations. There are two conſpicuous ſtars ſtanding one over the other at the bottom of the neck, or between that and the breaſt, and one not ſo large on the back. There are two very bright ones on the thigh of the leg that is lifted up, one on each ſide, or at the edge of each out-line, and near the knee; there is one at the lower part of the belly, two near the out-line of the thigh of the left hinder leg, one in each of the hinder feet, and three about the ankle of the left hinder leg. It is obſervable, that in the place where Hevelius has formed the conſtellation of the Little Lion, there are as large a quantity of ſtars as are to be found in an equal ſpace in any part of the heavens, and in this ſpot, occupied by the Camelopardal, are as few as can be found any where in an equal ſpace in the northern hemiſphere: there are, however, ſome conſiderable enough to countenance very well the forming of the conſtellation; and although few of any ſize, there are numbers of the ſmaller orders that make up the deficiency: the ſpace about this conſtellation is one of thoſe peculiar for the abundance of ſmall ſtars, as well as for the ſcarcity of larger.

CANCER, *the Crab.* One of the conſtellations of the northern hemiſphere, and a very conſiderable one; 'tis mentioned by the aſtronomical writers of all countries, and is not only one of the forty-eight old conſtellations, but a ſign alſo of the zodiac.

The Crab is not a conſtellation of very great dimenſions, nor is it remarkable either for the quantity of ſtars which it contains, or for their magnitude; nevertheleſs the principal among theſe are ſo fortunately diſpoſed in the ſeveral parts of the figure, that there are few conſtellations more ſtrongly marked, and ſcarce any more eaſily diſtinguiſhed in the ſkies.

The figure is very well drawn in the ſchemes of the heavens. There are, among the conſtellations, bears with tails, and hairy-headed ſerpents, and, in general, monſters as great as ever were formed by ſign-painters or heralds; but the Crab is not of this number, it is drawn in the ſchemes of the conſtellations in good proportion, and of its natural form.

The conſtellations about Cancer are Leo, Leo Minor, Lynx, Gemini, the Unicorn, the Little Dog, and the Hydra. The Lion is placed directly before it, they are face to face, and at a very little diſtance; and the Leo Minor is juſt over the head of that conſtellation. The hinder feet of the Lynx come very near the ſide of the Crab. The conſtellation Gemini is cloſe behind it; and the Unicorn, the Dog, and the Hydra, are in a line between the lower part of Gemini and the Lion. So that they are under the lower ſide of the Crab.

The antients counted twenty-three ſtars in the conſtellation Cancer. Hipparchus, who made the firſt catalogue of the fixed ſtars ever known of in the world, certainly ſet down ſo

many in it, for we find that number recorded by Ptolemy, who was his faithful follower.

Hevelius raised the number to twenty-nine, but Flamstead carried the account much higher; he numbers not less than eighty-three stars in it; of these there is not one star either of the first or second magnitude. There have been no more than two spoken of as belonging to the third, and these are not universally allowed that rank, but many degrade them into the fourth. One of these is in the southern claw, and the other at the second foot. There are but three or four so large as to be allowed even the fourth magnitude, the rest are in general very small: they are disposed irregularly in general, and some of them are out of the outline of the figure howsoever drawn, but in the whole they have something sufficiently determinate in their situation. There is a large one on one side of the head, and another not greatly smaller on the other; there are two or three luckily disposed in the thicker part of each claw, and some about the edges of the body, and distributed among the smaller legs that lie very well for observation: on the whole, there is scarce any one of the signs of the zodiac of more importance to astronomy than Cancer, and scarce any one better determined.

The Greeks, for they would have the origin, as well as the improvement, of astronomy, wholly among themselves, have contrived to adapt a part of their fabulous history even to this constellation. One would be puzzled almost to guess for what they should devise that a Crab should be exalted into heaven; but what will not poetic invention accomplish? They tell you, that when Hercules was fighting with the Lernæan Hydra, there was a Crab upon the marsh which seized his foot. The hero crushed the reptile to pieces under his heel; but Juno, in gratitude for the offered service, little as it was, raised the creature, they say, into the heavens.

The two principal stars which have been already named, as situated on the shell of the Crab toward the sides of the head, are called by the Greeks Aselli. The story they have given to explain the origin of these, is this. They say, that Bacchus, afflicted with madness by Juno, fled through Thesprolia toward the temple of Dodonæan Jove. They tell us, that in his way there lay a great marsh, over which he was carried by an ass, one of two which he saw toward the limits of the bog. They add, that, in return, he turned not only the creature which carried him, but both, into stars, and placed them in the constellation Cancer. Others say, that the first reward was his giving the ass an human voice; and, in consequence, when the creature was destroyed in a contention with one of their deities Priapus, that he then removed it, and its fellow, into the skies. Others tell us, that the asses are there placed in commemoration of the service they were of in the battles of the gods with the giants. They say that Bacchus and Silenus came on asses, and that the noise of their braying frighted the enemies.

These are the variety of fables invented by the Greeks to deify two stars which only make a part of this constellation. As to the Crab itself, they had enough to do to find one account of its exaltation, so have not troubled themselves to look for more. But although nothing more is to be enquired concerning it among them, something may perhaps be learned among the Egyptians. These people taught the rudiments of astronomy to the Greeks, and they had always a meaning in their figures. Hieroglyphic was their manner of writing, and every constellation in the heavens is a part of it. Macrobius has very happily explained this, and by that explaination he has opened the way to the understanding all the rest. It

It has been already obſerved, under the article Aries, that the Egyptians placed that animal firſt, the Bull ſecond, and the two Kids, for that was the figure of the original Gemini, third in the number of the ſpring ſigns; becauſe the Lambs, the Calves, and the Kids, were ſeen in ſucceſſion following one another along the fields at that period, and in that order. By the Crab they meant to mark that place in the heavens, at which, as one of the barriers of the ſun's courſe, when he was arrived, he began to go backward, and to deſcend obliquely. They therefore, as the ſtars which occupied this part of the heavens, might as well be deſigned under one figure of an animal, as another, choſe that of a Crab, a creature which, in its ordinary motion, goes ſideways and backwards. It was thus that the conſtellations were a part of the hieroglyphic language of the people who invented them; they came late among the Greeks, and nothing can be ſo idle as the cuſtom that obtained among them of adapting parts of their hiſtory, or of their fable, for that was more uſually the caſe, to figures intended to convey real inſtruction; and calling the figures deviſed by the Egyptians, and by them delivered to their ſages, by the names of heroes they had never ſeen or heard of.

The Greeks call this conſtellarion Carcinus and Octapus, and its name in the oriental languages is Sartan, Sartano, Alſertan, and Sarteno. Not one of all the conſtellations has been the ſubject of more romantic ſuppoſition, or more idle opinions. In the Chaldæan ſyſtem, which travelled into Greece, and many other of the moſt civilized countries, loaded with all its original abſurdities and follies, this ſign is ſaid to be the gate out of which the ſouls of men, created in the heavens, deſcended into human bodies.

The aſtrologers have been taught, by the old aſtronomers, to give one of the conſtellations of the zodiac to each of the principal deities; thoſe, as well as the ſigns, being twelve, the Crab was given to the god Mercury; and from this has ariſen all that unintelligible and ſtrange jargon among the aſtrologers, which talks of an alliance between the planet Mercury, and the conſtellation Cancer. The Chaldæans, for all this is from them, had a way of talking of reſemblances and analogies between certain of the planets, and certain ſingle fixed ſtars; but this was from the peculiar colour of theſe ſtars, which reſembled that of ſome particular planet. Thus ſuch of the fixed ſtars as have a reddiſh tinge, were ſaid to be of the nature of Mars, ſuch as had a yellowiſh caſt of Venus, and ſuch as were of a pure untainted white of Jupiter; and theſe differences of colour in the fixed ſtars, as well as in the planets, are obſerved at this time, but principally in thoſe countries where the air is cleareſt. Italy ſhews all theſe things much more favourably than France, and France than England. Even the ſpots of Venus, on which Caſſini had eſtabliſhed the revolution of that planet about its own axis, and which he had ſeen at Bologna, were afterwards ſought in vain by his ſon with the beſt apparatus of the Paris obſervatory; and very few of them are to be ſeen in England. Theſe colours of the ſtars were diſtinctly ſeen by the Chaldæans, though many late obſervers of the heavens, becauſe they could not ſee them in unfavourable climates, have diſputed it; but it is not to theſe that the aſtrologers refer, when they talk of the analogy between a planet, and a whole conſtellation.

CANDAEN. A name by which ſome, who love uncommon words, have called the conſtellation Orion. Lycophron tells us, that the Bæotians gave it this name, and that it

was long after called Oarion, and thence Rion. The old Latins call it Hyrides.

CANES VENATICI, *the Greyhounds, or, as some call them, the Hounds.* One of the new constellations of the northern hemisphere, or one of those which Hevelius has formed out of the Stellæ Informes, or unformed stars, of the old catalogues; and added to the forty-eight antient asterisms which we have from the Greeks, and which they had from the Egyptians. These two Dogs are distinguished by the peculiar names of Asterion and Chara, and are referred to in all the late astronomical writings, in which this part of the northern hemisphere is mentioned.

The Canes Venatici form a constellation of tolerable extent, but the quantity of stars comprised in it, is not great in proportion to that space it occupies in the heavens. And even of these, the greater part are small and inconsiderable; there are however enough that are of consequence to make the arrangement of them into this constellation very useful, since before it was not easy to refer to, or to mention them.

The new constellations in general are better drawn than the old ones. The Bear, which these Dogs are following, is furnished with a long tail, an appendage which no bear on earth ever had, however common it may be to the two that are in the heavens: and in the same manner the dragons have hairy heads, and so of many other of the figures; but it is not so with respect to these; the two Dogs are very naturally, and very properly drawn, and they are indeed so well characterised, as of the Greyhound kind, that it is almost unpardonable in any to have called them Hounds.

The Greyhounds are situated between the Great Bear Bootes, and the Coma Berenices; there is a space between these three constellations, with some remarkable stars in it; and Hevelius has so designed the figures of his Greyhounds, that they very happily fill it, and comprehend those stars which were before left unformed in it. They are drawn in a posture of running, and have their mouths open, as if barking; at the same time. They have slender bodies, long legs, and curling tails; and they have each a collar round its neck, from which is carried a cord or string up to the left hand of Bootes, who holds it up, and seems to manage them at his pleasure. They are placed one over the other, and both under the left hand of Bootes; the tail of the upper comes just to his side, and that of the lower to the skirt of his robe; the hinder part of the Great Bear is just before them; its tail is carried over the head of the upper Dog, and the Coma Berenices is under the other, at a small distance.

It has been observed, that the space of the hemisphere, where these stand, is not peculiarly filled with stars. Where Hevelius has placed the little Lion, there were a vast number more than perhaps in almost any of the constellations under an equal extent; but it is just otherwise in this; there is scarce an equal space in the northern hemisphere, where there are so few. Hevelius, who formed the constellation, reckons only twenty-three stars in it, and most of these small; and Flamstead has encreased the number but by two; he, who has often more than doubled Hevelius's account, here only puts twenty-five for his twenty-three.

Of these twenty-five stars in the Canes Venatici, there is not one of the first magnitude, but there are a few considerable enough to be remarked. There is one in the ring that fixes the cord in the hand of Bootes to the collar in each, and that in the lower Dog is the largest

largeſt and brighteſt ſtar in the whole conſtellation. There is a ſingle ſtar over the eye of each Dog, and in the lower one's head there is alſo another ſingle ſtar forwarder: there is alſo one in the neck, and one on the body of the lower Dog, and another juſt behind his hinder foot. Beſide theſe, there are to be mentioned a cluſter of four between the two Dogs; and a couple ſo cloſe, that they look only like a ſingle ſtar over the back of the lower. Theſe are all the ſtars that are any thing conſiderable, and that belong to the Canes Venatici; but theſe are ſo diſtant from the out-lines of thoſe conſtellations to the figures of which they had uſed to be referred under the name of unformed ſtars, that it is a a great aſſiſtance to the ſpeaking of them to be able to ſay the ſtar over the eye of Aſterion, or that in the collar of Chara. It were well if Hevelius had not ſtopped where he did, as it would have been eaſy to have added more to the conſtellations, and all for the advantage of the ſtudy.

CANICULA. A name given by many of the earlier aſtronomers to the conſtellation which we call the Leſſer Dog, and Canis Minor, and ſome Procion and Ante-canis. *See* Canis Minor.

* CANIS is the name alſo of a ſingle ſtar, the bright one between the feet of the conſtellation Cepheus. To explain this name we are to obſerve, that the Arabs had a cuſtom of giving names, not only to conſtellations, but to ſingle ſtars in and about conſtellations. Thus they called the bright ſtar in the foot of Cepheus Al Rai, and this between his feet Al Kelb. Now Al Rai ſignifying a ſhepherd, and Al Kelb a Dog, the Latins, who have followed their opinions and cuſtoms, have called the one Paſtor, and the other Canis. The Arabs have made out the whole matter in this ſign, for they have not only thus named the Shepherd and his Dog; but they have called certain ſtars in his hands the Sheep Al Aglinam, and theſe have been called by ſome Pecudes.

Canis is alſo one of the Arabian conſtellations ſtanding in the place of Cepheus. They were forbidden by their law to delineate the figure of any human creature, ſo they diſplaced Cepheus for this animal.

† CANIS MAJOR, *the Greater Dog*. One of the conſtellations of the northern hemiſphere, and one of the moſt remarkable among them. It is one of the old forty-eight aſteriſms which the Greeks borrowed from the Egyptians, and it is mentioned by all who have written on aſtronomy.

Although ſo very noted a conſtellation, the Dog is not of ſo great extent in the ſkies, as many others; but the regard that has been paid to it is eaſily accounted for. It contains as many ſtars, perhaps more than any conſtellation in the heavens, and certainly more that are conſiderable; beſide that, there have been peculiar reaſons for marking its riſing.

Its poſture in the hemiſphere is a very extraordinary one; it would be natural to ſuppoſe, that by its nearneſs to the Hare it was running that creature down, or by its nearneſs to the hunter Orion, that it was following him in ſome chace; but it is otherwiſe expreſſed by the poſition; it is a Dog ſitting upon his haunches, and in the poſture in which we make ſpaniels beg. The figure however is very well marked by the ſtars which belong to it, and it is better drawn than that of many of the other conſtellations, though with regard to this perhaps it would not be eaſy to ſay to what kind of Dog it belongs.

The conſtellations between and among which

which the Canis Major is placed, are the Ship, the Unicorn, the Hare, Orion, and the Pigeon. The ſtern of the Ship is almoſt cloſe to his tail, the Unicorn is galloping over his head, the ſhoulders of that figure are juſt over his ears, the Hare is ſtrait before his fore feet, and, at a very little diſtance, Orion ſtands over the Hare, and the Dove, with the olive-branch, is juſt under his hinder feet.

The antients, who paid a great deal of regard to the Great Dog, counted no ſmaller a number than twenty-nine ſtars in the very moderate limits of that conſtellation. Ptolemy gives that number, and he followed Hipparchus, and all the others him. The later writers have not allowed ſo many till the time of Flamſtead; Tycho Brahe mentions only thirteen; Hevelius make them but twenty-one; but Flamſtead raiſes the number to thirty-one.

Of theſe there are more of a conſiderable ſize than in any other conſtellation whatſoever, and more ſuch than are to be ſeen together in any part of the heavens beſide. There is one of the firſt magnitude; this is in the mouth of the conſtellation, it is called by a particular name Sirius, and is the largeſt and brighteſt of all the fixed ſtars. There are in general accounted no fewer than ſix of the ſecond magnitude, but ſome diſpute three of them. The three which are allowed are two of them, on or before the hinder feet, the figures generally leaving them unformed: and the third is in the paw of the fore foot. Of the three which are diſputed, one is in the preceeding poſterior feet, a ſecond is the bright one under the belly between the thighs, and the third is the brighteſt ſtar in the tail. Beſide theſe there are one or two allowed of the third magnitude, and ſome of the fourth. This account will ſpeak a great ſhew of light in ſo ſmall a compaſs, to thoſe who are acquainted with the general form and compoſition of the conſtellations. Indeed when we conſider how ſmall the number of the firſt and ſecond ſtars in the hemiſphere is, we ſhall know that they are beſtowed in an uncommon profuſion upon this conſtellation. The ſmaller ſtars which belong to it are diſtributed over the body, and about the legs, but not ſo equally as in many of the conſtellations; there are more toward the back than elſewhere, and but few about the lower part of the body.

The Greeks, whoſe ambition it has always been to claim the origin and invention of the ſciences, have attempted to make the world believe, that the conſtellations were firſt formed among them, by adapting a part of their own hiſtory, or their own fables, to every one of them. So conſiderable a conſtellation as the Dog, could not eſcape without a peculiar attention of this kind, and we do indeed find that they have been buſy upon the ſubject.

They tell us, that when Jupiter had run away with his favourite Europa, he appointed this Dog to be her guard in his abſence, and that he was ſo aſſiduous and faithful, that the god beſtowed particular honours on him. Procris, the unhappy wife of Cephalus, they tell us, cured the creature of ſome malady that had befallen him; and the charge of Europa being now at an end, ſhe received the creature, on whom ſhe had beſtowed the benefits, as a preſent for her pains, with this peculiar advantage, that no creature ſhould eſcape it in the chace. On the unhappy death of Procris, they ſay, the Dog became the property of her huſband. Cephalus took him to Thebes, where there was ſaid to be a fox that had, for ſome peculiar benefit, received the power from ſome of their deities of eſcaping whenſoever he was purſued. Cephalus, perhaps a little incredulous, perhaps only curious, turned this

Dog,

Dog, whom no creature was to eſcape, looſe againſt this fox, which no creature was to take. All Thebes beheld the chace, but it could never end by natural means, for the gift was fixed to both. Jupiter, who had beſtowed it, after a long and wonderful purſuit, turned both of them, in their poſture of running, into ſtones, and afterwards took the Dog up into the heavens and made a conſtellation of him.

'Tis pity that theſe relaters of miracles never know where to ſtop. They are not contented with this ſtrange ſtory, but, while ſome adhere to it, others invent others. Some ſay this was the Dog of Orion uſed in his hunting, and carried with him into the ſtars. Others call it the Dog of Icarus, and others give it other maſters.

It is not among the Greeks that we are to look for the real origin of the conſtellations. The name Sirius is given in common to this whole conſtellation, and to the ſingle ſtar which is in its mouth. We find, by the accounts tranſmitted to us of the Egyptians, that they watched the riſing of this ſtar, and by it judged of the ſwelling of the Nile. They called the Nile Siris, and thence their Oſiris; and nothing can be ſo natural as their naming the ſtar which they conſulted about its ſwelling by a name formed from its own. This is doubtleſs the origin of the name Sirius, which has been given as well to the great ſtar in the mouth ſingly, as to the whole conſtellation; and if we enquire after the occaſion of the general figure, we ſhall find a dog the moſt likely of all animals in the creation to have been ſelected by the Egyptians on ſuch an occaſion. The Nile was ſtill at the bottom of the appropriation; they called Sirius the ſtar of the Nile, and they always knew, that, when this ſtar got out of the ſun's rays, and began to appear, a time of great conſequence to them was approaching. When they firſt ſaw Sirius before day-break in the ſkies, they knew the ſun was under Leo, and that the riſing of the Nile followed, for this was conſtant and regular. The preſage of this ſtar was therefore to them, whoſe harveſt, and whoſe immediate means of life, depended on the overflowing of this river, a thing of ſuch vaſt importance, that they counted their year from it. The riſing of Sirius was their new-year's-day, and all their feſtivals followed in a proper ſucceſſion. They called this ſtar the centinel and watch of the year, and they, according to their manner of hieroglyphical writing, repreſented it under the figure of a dog; and they worſhipped it alſo in this form, or in a form partly that of an human creature, and partly that of a dog, under that name.

Schiller deſires this conſtellation may be underſtood as a remembrance of Tobit's dog. But Schickard is not ſo eaſily ſatisfied in his ſcripture references. He has formed a new conſtellation out of the ſtars which compoſe it; and he calls this David.

CANIS MINOR, *the Leſſer Dog*. One of the conſtellations of the northern hemiſphere, and though a very ſmall, yet by no means an inconſiderable one. It has been a cuſtom (not only in this caſe) to expreſs ſeveral ſtars in different parts of the heavens under the figures of the ſame animal, only larger and ſmaller; but it is not an eligible one. We have the Greater and Leſſer Bear, as well as the Greater and Leſſer Dog; and in the ſame manner we have conſtellations of the ſame name and figure, diſtinguiſhed only by their being in one, or in the other, hemiſphere. But this is idle, there are creatures enough in the ſublunary world to have afforded forms and figures for the arrangement of all the ſtars in heaven, and it would have been much better that they ſhould all have been called in, than that there ſhould

have

have been this occasion of confusion upon the names. We are, however, to take things as they are, for to alter them now would be to encrease, not remedy, the fault.

The Little Dog is mentioned by all the writers on astronomy, and is one of the forty-eight old constellations. It is of very small extent, and it contains very few stars; yet some of these are so considerable, that it is very easily distinguished.

The Little Dog is represented in the heavens in a more natural posture than the great one. It is placed on its legs standing, and rather in a fixed than moving posture; and its head is usually raised as if in a posture of barking or howling. The figure is a very natural one, that of a shock or long-haired spaniel, and has nothing of that absurdity which is frequent among the drawings of the creatures of the heavens. The constellations about it are the Hydra, the Crab, the Unicorn, and Orion. The head of the Hydra is directly behind it, but at some little distance, and that head alone is equal to the whole figure of the Dog. The Crab is at some distance over, and behind him. The Unicorn is directly under him, his feet come near its neck; and Orion is at some distance before him, for the horn of the Unicorn goes over the wrist of that constellation. The Little Dog makes but a very inconsiderable figure among these great constellations: but it is very easily distinguished.

The antients, although they paid a sufficient respect to this constellation, counted only two stars to the formation of it, but they were large enough to be remarkable. Ptolemy sets down no more than these two, and he followed Hipparchus strictly. Tycho Brahe has not added any thing to the number; Hevelius indeed makes them thirteen; and Flamstead, who usually adds more largely to the numbers of Hevelius, has only given one more; he sets them down fourteen. Of these there are only two of considerable size, these are the two mentioned by the old writers, the one of them is, by most, called a star of the first magnitude, though there are those who degrade it into a second. This is in the thigh of the right hinder leg, and is called Procyon. The other is only of the third magnitude, and is in the neck. There is one of the fourth, four of the fifth, and the rest are of the sixth magnitude: they are distributed tolerably regularly over the several parts of the animal.

The Greeks, who will leave no constellation unexplained by some part of their history or fable, tell us, that this, whatsoever may have been the case with the Greater Dog, was one of Orion's hounds, and taken up with him into the skies; but as the posture of the other declared against its belonging to him, the place of this does the same, for it is not following at his feet, but is upon a level with his shoulders. The Egyptians were, doubtless, the inventors of the constellation, and they gave it this figure to express a little dog, or watchful creature, going before as leading in the larger, for that is the case with the stars of this constellation with respect to that of the Greater Dog, which it precedes or leads in; rising before it: and it is hence the Latins have called it Ante-canis, the star before the Dog.

The enthusiastic Schiller, who has reformed, as he calls it, the whole sphere, has called this constellation by the name of the Lamb, or the Paschal Lamb.

CANIS FŒMINA, *the Bitch.* One of the Arabian constellations. They put a Bitch in the chair in the place of the woman in the constellation Cassiopeia. This is not to be understood to flow from any disrespect they bore to the lady, but they were not permitted, by their religion, to draw any human figures, and

and consequently, having retained the chair in this constellation, they placed this quadrupede in it.

CANOPUS. A name given by some of the old astronomers to a single star, one of the unformed ones, under the second bend of the Eridanus. These writers say, the river in the heavens is not the Eridanus, but the Nile, and that this star commemorates an island made by that river, and called by the same name. Some call also by this name a star in Argo.

CANTARATOS. A name by which some have called the bright star Arcturus. We find the name in Bulialdus, and from him many, who are fond of writing obscurely, have borrowed it.

CAPRA. A name given by some to the bright star in the constellation Auriga, near the shoulder, and above the two other bright ones in the arm of the same constellation, which are called Hædi, the Kids. These names have been given in very early times to these stars, and this large one called the Goat, has been supposed placed there in honour of the creature of that species, which gave suck to the infant Jupiter. There are some indeed who would rob the Goat of this honour; they say, he was suckled by a sow, and produce, as a testimony of this, the divine honours, that were in old time, paid by the Cretans to that dirty animal; but the general testimony is against this; and we find the Goat restored to her honours by most, and supported in them, not only by innumerable testimonies of the poets, but by medals. There are at this time coins of Valerian extant, on the reverse of which is a child riding on a Goat, and the words Jovi Crescenti. This assures us, that the Goat is the animal which has a right to this place in the heavens, if the star be named in commemoration of this nurse of the fabled deity. Some have put a sow in the arms of Auriga on this foundation; but a Goat is the proper animal.

CAPRICORNUS, *Capricorn.* One of the constellations of the northern hemisphere, and one of the twelve signs of the zodiac. It is one of the forty-eight original constellations which the Greeks received from the Egyptians, and has travelled down through all ages and nations without any alteration in the figure or place. It is not one of the largest among the constellations; but neither is it a very small one. The quantity of stars which it contains, is less in proportion to the space it occupies in the heavens, than that of many others of the constellations.

The figure of Capricorn is singular enough. It is a general observation, that the animals of the zodiac are more like those of the world, than the figures of those which make the other constellations; but Capricorn, and his neighbour Sagittary, are to be excluded from this acknowledgment. The Archer is a kind of Centaur, a creature half man, half quadrupede; and the Goat, which they call Capricorn, has the tail of a fish, and has the legs of a quadrupede, indeed only on the fore part. This creature of the inventor's fancy, for the earth or sea affords none such a real existence, is represented in a posture of rest, one foot is doubled under it, and the other is idly protended forward, or seems so, being dangling down. The head is that of a Goat, the horns are moderately long, the neck, breast, and the shoulders also belong to that animal, but from thence to the extremity of the hinder part it is fish; there is a fin at the side, and another must be supposed correspondent to it, and opposite, and a little beyond this the body grows

small,

ſmall, and is twiſted round, turning up at the end where there is the tail of a fiſh, compoſed of three parts, a middle prominence, and two ſide points.

The conſtellations, between and among which this of Capricorn is placed, are Aquarius, the Dolphin, Sagittary, and one of the fiſhes, the lower of the two. It is extremely cloſe to the two ſigns of the zodiac between which it ſtands; the foot which is protended reaches almoſt to touch the hinder part of the Horſe's body in Sagittary, and the tail of it abſolutely lies upon the body of Aquarius, covering a part of his left ſide, juſt under the breaſt, ſo that the ſtars there, may, with equal propriety, be ſaid to be in the tail of Capricorn, or in the ſide of Aquarius: the Dolphin is over the head of Capricon, but at a very conſiderable diſtance; and the lowermoſt of the fiſhes has its tail very near the bended foot of this conſtellation.

The oldeſt and the lateſt writers, until the days of Flamſtead, agree very nearly in their account of the number of ſtars in Capricorn. Ptolemy ſets down twenty-eight, and we may be aſſured this was the original computation, for he is a religious follower of Hipparchus. Tycho Brahe has ſet down the ſame number twenty-eight; and Hevelius has added only one, he makes them twenty-nine. Flamſtead has greatly ſwelled the account, but yet not nearly ſo much as in ſome of the other conſtellations. The ſtars in Ptolemy's account of Sagittary are thirty-one, and Flamſtead mentions ſixty-nine. Theſe in Capricorn are twenty-eight in Ptolemy, and he makes them fifty-one. Of theſe there is not a ſingle ſtar of the firſt, or indeed of the ſecond magnitude. There are only four ſpoken of, as of the third, and one of theſe is diſputed, and referred by many to the fourth. The firſt of thoſe of the third magnitude is in the right, and the ſecond in the left hand, there is another of them at the root of the tail, and the other is very near to this: there are ſeveral of the fourth magnitude, and all the remainder are not of the very ſmalleſt ſizes. The large ones are all, either toward the tail, or about the head, but the greateſt part are toward the tail. The reſt are diſperſed with an equal hand over the greateſt part of the figure, the neck and breaſt have the feweſt of any part, but they are not altogether without. It is owing to this equal diſtribution of the ſtars that the conſtellation of Capricorn is very eaſily ſeen and diſtinguiſhed in the heavens, although it have none very conſpicuous.

The Greeks, who would have all the aſtronomy of the world ſeem to be derived from them, and who adapt ſome part of their hiſtory to each conſtellation, that they may have the credit of being its inventors, tell us, that this is the famous Ægipan. Jupiter, they ſay, becauſe he was brought up by this creature, took it into the heavens. They call it alſo ſometimes ſimply Pan; and they ſay, this is the creature which was the author of thoſe terrors which have thence been called Panic fears. The old writers all agree, that the giants, in their war with the gods, were frighted by the noiſe of ſome animal in the heavenly party. The braying of an aſs, on which Silenus rode, is, by ſome, ſaid to have been this terrifying ſound; and others ſay, that it was the howling of this animal. They give this account of the hinder part of the figure being made like that of a fiſh, that when it had began to terrify the adverſe party with its uncouth noiſe, it threw at them ſea-ſhells and maſſes of corals, and the like, by way of ſtones. This, however, ſerved but ill the purpoſe, for there appeared

peared difficulties in the way of the exploit. They had recourſe therefore to older hiſtories, and brought in the fables which they had learned from the Egyptians, to aſſiſt in the explication of the figure. They tell us, that, according to the Egyptian hiſtory, at a time when there were many gods together in that country, there appeared among them a moſt terrible giant, Typhon, a declared enemy of all the celeſtial people. They don't allow this Typhon the dignity of a deity, but they ought in all good reaſon, for he made them all tremble. They changed all their forms, that they might be hid from this terrible enemy; and to this they attribute the Egyptian worſhip of the ſeveral animals. Mercury, they ſay, changed himſelf into the Ibis, Apollo into a thruſh, and Diana into a Blackbird; and this they give as the reaſon why the Egyptians would never after ſuffer thoſe birds to be deſtroyed or injured. 'Tis to this metamorphoſis among the deities that they aſcribe the origin of the Ægipan, or what we call Capricorn. The god Pan, they ſay, threw himſelf, in the fright, into the Nile, and that his hinder parts became changed into fiſh, while, in the reſt, he reſembled a goat. 'Twas under this form, they ſay, that Pan eſcaped this terrible Typhon; and they add, that Jupiter, who was all this while ſafe in his own territories, in commemoration of the exploit of Pan, took up the creature into the heavens, and made it one of the twelve ſigns of the zodiac.

It is indeed among the Egyptians that we are to look for the origin of the conſtellation, but we are not to trace from it this fabulous foundation. They were the people from whom the Greeks obtained their knowledge of the conſtellations, but it was not on accounts like theſe, that they contrived them. They did not commemorate ſtories of heroes, or of gods in theſe figures, whatever the Grecian genius for fable might do of this kind; but they intended the ſigns of the zodiac to mark the ſucceſſion of the ſeaſons: and they choſe for the figures, under which they ſhould arrange the ſtars belonging to them, thoſe of animals, whoſe qualities or characters conveyed ſome idea of what was to happen when the ſun came to that place. The two ſigns which mark the tropics, or barriers, which bound the ſun's courſe in the zodiac, are a Crab and a Goat; for as to the fiſhy part of the figure, we are not enough in the ſecret of their hieroglyphics to underſtand it. The Crab, which is an animal that walks backwards and ſideways, was the mark of that part where the ſun went obliquely, and deſcending, in the lower part of his courſe; and, on the other hand, when they were to collect into ſome figure thoſe which occupied that ſpace in the heavens at the ſun's approach to which he quitted his lower courſe, and aſcended more and more, they choſe for the repreſentation the Goat, an animal that is always climbing the ſides of mountains. This was beyond a doubt the origin of the conſtellation; and it is no new ſolution, for Macrobius has obſerved it.

There is hardly any conſtellation more famous in the antient mythology, or more frequently named by the early writers than this. The Pythagoreans call it the gate of heaven, and ſuppoſed it the part of the ſkies opened for the paſſage of the ſouls of good men into heaven. The Romans gave one of the twelve months of the year to the protection of each of the twelve principal deities, and in the ſame manner they put into the protection of each of them one of the twelve ſigns of the zodiac. This was given to the tutelage of Veſta.

The poets have celebrated it on a number of occaſions. Among the Romans it was almoſt worſhipped for having ſhed its influence on the birth of Auguſtus.

In Augusti felix quod fulserit ortum.

The mariners also feared it, and prayed to it; (for these people worshipped every thing they feared, as the Indians do) on account of its presaging, or, as they understood it, causing tempests. It is on this account that Horace call it,

Tyrannus
Hesperiæ Capricornus undæ.

It was in the western ocean that it was supposed to possess this power of mischief in the greatest degree. And hence some of them gave every thing in the west to its influence.

Tu Capricorne regis quicquid sub sole cadente.

And the Hesperian seas are recorded by Propertius, as by Horace, with its name:

Lotus et Hesperia quid Capricornus unda.

We see the image of it on the reverse of some coins, struck in memory of naval dangers, and we read of it ennobled almost to the rank of a deity in the votive tables.

CARCINUS. A name by which some of the astronomical writers, following the Greeks, have called the constellation Cancer, one of the twelve sings of the zodiac. *See* CANCER.

CARNABOS. A name by which some of the old astronomical writers have called the constellation Ophiucus. They say, that the sign was formed in memory of a king of the Getæ of that name, who attempted to kill Triptolemus, whom Ceres had sent to teach mankind the arts of agriculture. Carnabos, they say, killed one of the dragons that drew his chariot, and the goddess, by way of example to mankind, placed here his figure, struggling with the Serpent. But this was an odd way of punishing a man. *See the article* OPHIUCUS.

CASSIOPEIA. One of the constellations of the northern hemisphere, at no great distance from the pole. It is one of the forty-eight old constellations, and is mentioned by all the writers on astronomy. It is of considerable extent in the heavens; much less than Hercules, Cepheus, or Bootes, but equal to the Swan, or Lesser Bear, and it contains a proportionable number of stars.

The figure is that of a woman sitting in an arm chair, with very little covering, and with both hands raised up, in the left she holds a branch of palm, and in the right a part of her loose robe continued from her head. The chair is represented with a twisted back, and with a festoon, continued transversely. These are parts necessary to be named, because there are stars, and those considerable ones, situated in these several places. The Arabians, who are forbidden by their law to draw a representation of any human figure, have not transgressed the command, even with respect to the constellations; they have put animals in the places of human figures throughout them. A Camel kneeling, is in the place of Hercules, and there is a bitch in a chair, in the place of Cassiopeia.

Cassiopeia is situated between Cepheus, Andromeda, and Perseus. Cepheus is behind her, the hand which holds his sceptre comes very near to the hinder part of her chair; Andromeda and Perseus are before her, the one toward her head, the other toward her feet; the right foot of Andromeda comes near her left elbow, and the sword of Perseus comes very near her arm, in which the palm-branch is held.

The

The antients were well acquainted with this conſtellation, they counted only thirteen ſtars indeed in it, but they were in moſt caſes below the true number; either reckoning only thoſe ſtars within their out-lines of the figure, of which, as we have none of their drawing preſerved, we therefore cannot judge; or only counting the principal and moſt conſpicuous. Hipparchus has allowed thirteen ſtars to Caſſiopeia, and Ptolemy has given it the ſame number. Tycho, who ſometimes reduces the account in the conſtellation below the old number, has ſwelled this to twice the quantity. Hevelius, who followed him, has carried it yet farther, he counted thirty-ſeven ſtars in Caſſiopeia, and Flamſtead no leſs than fifty-five.

Among this number there are not any that are very conſiderable in ſize. There are only two of the fifty-five which have been accounted by any to be of the ſecond magnitude, and even theſe others have reduced to the third; for the determination in this reſpect is very arbitary, no bounds or limits being fixed for either order. Theſe are the one in the middle of the feſtoon in the chair back, called Lucida Cathedræ, and the other the large one in the breaſt.

There has indeed appeared a ſtar, and a fixed ſtar too, much ſuperior to what are called ſtars of the firſt magnitude, in this conſtellation. It was larger to appearance than the planet Jupiter, and appeared, as is ſaid, at once in its full luſtre. It was in the year 1572 that it was ſeen, and it laſted eighteen months; but all the time diminiſhing in ſize and brightneſs. This will be mentioned at large hereafter, under the article of NEW STARS; it is one of thoſe, and is indeed to be reckoned to the account of the conſtellation properly counting, for, although not ſeen at all times, it is doubtleſs always there, either it revolves in a long period round its own axis, and has a dark and an enlightened ſurface, which it at times preſents to us; or it has its face liable on occaſion to be obſcured with ſpots altogether, as we ſee that of the ſun in part, and therefore is only viſible at certain times. This is more conſpicuouſly the caſe with ſome other of the ſmaller new ſtars, as they are called; but it is probably the ſame regulation that holds with reſpect to all.

The reſt of the ſtars in Caſſiopeia are diſpoſed with a great deal of equality over the whole conſtellation, much more ſo than is uſually the caſe; there are two conſiderable ones in her face, two or three in her arms, three in the palm-branch, and ſeveral on her legs and body, as well as on the different parts of the chair.

The Greeks probably received this figure, as they did the reſt, from the Egyptians, and not knowing to whom elſe they ſhould attribute it, they added it to the family in the neighbouring part of the heavens. They make her the wife of Cepheus, and mother of Andromeda. They repreſent her as having been very proud and handſome, and relate a ſtory of her, having provoked the Nereids to ſtand the compariſon of beauty with her, in conſequence of which, they ſay, ſhe was thrown up among the ſtars, and there placed with her head downwards, as a puniſhment for her confidence and pride.

We find the figure was not univerſally allowed to this conſtellation; for beſide the Arabs placing a Dog on the chair or throne, we ſee many old writers calling the whole aſteriſm by the name of the Carion, or Laconian key.

Si

Si qualem Cariæ quondam
Noverat intrantem per claustra tenacia clavem
Formatur stellis distantibus.

But the generality of the old poets call it Cassiopeia. Manilius gives it this name, and even commemorates the occasion of her obtaining this situation in the heavens. He calls it being made conspicuous by way of punishment, and supposes her placed there to see the destruction of her favourite daughter Andromeda, who is chained just by her to the shore, to be devoured. In the same manner also the British poet, who calls it

That star'd Æthiop's queen that strove
To set her beauty's praise above
The sea nymphs, and their powers offended.

This was the original, and this has continued to be the general sense of astronomers about it.

Among the enthusiasts, who would have scripture stories commemorated by all the constellations, we find Schiller calling this Saint Mary Magdalen; and Hartsdorf, who always has recourse to the Old Testament on these occasions, calling it Bathsheba.

CASTOR. According to the Greek fabulists, one of the names of the constellation Gemini. They supposed the two figures, which, from the original pair of Kids some of their predecessors had raised up two children, to be Castor and Pollux. *See* GEMINI.

CATALETTO. A name by which the Italian writers have called the constellation Ursa Major; they have the custom from the Arabians, who call the Greater and Lesser Bear the Feretrum Majus, and Feretrum Minus; the word Cataletto signifying bier in their language. *See* URSA.

CATHEDRA. A name by which some have called the constellation Cassiopeia; it is one of the old Latin names, mentioning the chair instead of the person sitting in it. They called it also Sedes and Thronus, and Sedes Regia; and the Greeks by a name expressing a woman on a throne.

CAUN. A name by which some, who affect to use uncommon words, call the planet Saturn. It is one of the old oriental names of this planet. The Chaldees used it.

CECROPS. A name by which some of the old astronomical writers called Aquarius. They tell us that he reigned before the use of wines was known, and that the urn was a symbol of the use of water in sacrifices in those very early ages. *See* AQUARIUS.

CEDRON. According to Schickard, and his followers, one of the constellations. 'Tis one of those which they have not new-formed, but only new-named. This author calls the Eridanus by the name of the brook Cedron, mentioned in the scriptures; but Schiller desires that it may be called the Red Sea through which the Israelites passed.

CELESTIAL CIRCLES. There is no point, nor any circle on the earth that may not be conceived as extended up to the heavens, or the region of the fixed stars: it there assumes the same name, only with the addition of the word celestial, to distinguish it from that which is understood as described on the earth's surface. All the circles therefore, which we see marked on the convex globes of the earth, we may suppose

pose continued strait up, and marked upon the concave sphere of the heavens.

Thus the poles of the earth, to begin with those points (for on their situation depends that of some of the principal circles) are supposed continued up to the skies, and are there called the celestial poles, or the poles of the heavens. The earth revolving upon her own axis, that axis, considered as a strait line passing through its centre, must come to the surface in two opposite points, and these two points are called from their place on its surface, the poles of the earth, the north and the south pole. This axis of the earth, if supposed continued through the earth, and each way carried up to the sphere of the heavens, would touch that sphere in two points exactly corresponding to the two poles of the earth. These are fixed points therefore in the heavens, under the names of the arctic and antarctic pole, and sometimes under the names of the north and south pole, though that less properly, because it confounds them with those of the earth.

From these two points upon the earth's surface is made its first division. This is done by a great circle encompassing the whole surface of the globe, and placed at an equal distance from the two poles. This circle is called the equator, and, in common speech, the line. If the plane of this circle be conceived as extended like the two points or ends of the earth's axis up to the starry heaven, it will become a circle passing in the same manner round the whole concave of the heavens at equal distance from the two poles of the heavens, and it will describe what is called the celestial equator.

For the farther division of the earth in the same directions, we conceive certain other circles, as many or as few as we please, encompassing the surface of the earth between the equator and either pole. These circles, being in all parts at equal distance from the equator, and consequently in all their parts at equal distance from the pole, run parallel with the equator, and are thence called parallels to it, or, in simpler expression, parallels. These may, in the same manner as the equator itself, be all considered as removed into the sphere of the heavens, and they will there describe parallels also to the equator, which will be called parallels, and parallels to the equator; as well in the skies as on the ground. As these parallels are smaller and smaller in extent on the earth, as they recede, from the equator, and approach toward the pole, so it is also in the heavens, those are the largest which are nearest to the equator, although none is altogether so large as the equator; and those are smallest which are nearest to the poles of the heavens.

When the earth is thus divided by the equator into a northern and southern hemisphere, and each of those hemispheres is again divided in a parallel direction, into portions of what extent we please, by parallels drawn at different distances, it is next required, as these parallels will mark the distance of places, north or south, that is toward the north, toward the south pole, to find some other division of the earth, in consequence of which their distances, east and west, may be ascertained; that by this means the absolute place may be determined. To this purpose a secondary circle must be devised, that is, a circle, which shall cut the great circle already established at right angles. To this purpose men establish what they call a meridian, a first meridian, or great meridian, in some part of the earth's surface. This is a great circle of the earth, passing over the place from whence it is named, through both the poles. The Greeks made this pass over the island of Hera, one of the fortunate isles, probably our Teneriffe, and many of the moderns

derns have followed them, making the meridian paſſing over the Pike of Teneriffe, to be the firſt, or the great meridian. But in this they are not agreed, nor have they the ſame reaſon for agreement. The Greeks meaſured in longitude only from the weſt eaſtward, ſo that they naturally choſe for their firſt meridian the moſt weſtern part of the earth that was known to them; but we meaſure from it each way; and as we ſpeak of the diſtance of places in longitude eaſt and weſt, we uſually fix this firſt meridian at the place where we write.

Whereſoever this meridian is placed, it becomes a circle, which paſſing through both the poles, and cutting the equator at right angles, divides the earth into two equal hemiſpheres eaſt and weſt, as the equator had divided it into two hemiſpheres north and ſouth. Thus the ſurface of the earth being divided into four quarters, it is eaſy to ſay in which of them any place that is mentioned lies, and with a very ſmall addition to aſcertain the very ſpot.

As the aſtronomer conceives a number of circles, as many as he pleaſes, marked on the ſurface of the earth parallel to the equator, and called parallels; ſo he conceives a great number of circles, as many as he pleaſes, drawn on the ſurface of the earth like the firſt meridian, each paſſing through both the poles, and cutting the equator at right angles: theſe are all of them called meridians, and are named from the places over which they paſs, as the meridian of London, the meridian of Paris, and ſo of the reſt.

As the diſtance of a place from the equator, that is, its latitude, is determined by the parallel under which it lies, meaſured upon the meridian; ſo the diſtance of any place from the firſt meridian, eaſt or weſt, that is its diſtance in longitude, is marked by the meridians, and meaſured upon the equator.

Now, as the circles of the ſphere of the heavens, have their origin from theſe on the ſurface of the earth; we find that as theſe meridians are all circles cutting the equator of the earth, and paſſing through both its poles, ſo there are conceived, in the concave ſphere of the heavens, a number of circles (as many as the obſerver pleaſes) cutting the celeſtial equator at right angles, and paſſing through both the poles: theſe are called circles of declination; and the uſe of them is to meaſure the diſtance of any point of the heavens from the equator. Thus, if we are to ſpeak of the place of any fixed ſtar, or any other of the luminaries, as above or below the equator, the term uſed to this purpoſe is the declination of that ſtar, north or ſouth of the equator. 'Tis from this that theſe ſecondaries to the equator are called circles of declination; and as every circle of the ſphere of heaven, as well as that of the earth, is conſidered as divided into three hundred and ſixty parts, called degrees, and each of theſe degrees into ſixty minutes, and ſo on by ſixties; the place of the ſtar is eaſily meaſured upon one of theſe circles, being the arc of that circle intercepted between the ſtar's place and the celeſtial equator; which diſtance is meaſured in degrees, numbers, and ſeconds, upon one of theſe circles of declination, paſſing through the point of heaven in which the ſtar is; and this declination is either north or ſouth, as the ſtar is on one ſide, or on the other of the equator.

CENTAURUS, *the Centaur*. One of the old forty-eight conſtellations mentioned by all the Greek writers on aſtronomy, and from them taken into the ſchemes of the heavens by thoſe of all other nations. The Centaur is a conſtellation of conſiderable ſize, and although it does not compriſe a number of ſtars ſo great in proportion to its extent as ſome others, it has ſo many conſiderable ones, and thoſe diſpoſed ſo happily, that it is very conſpicuous.

It

It is reprefented, in all the fchemes of the heavens, in form of that imaginary creature formed of the human figure and that of a horfe. It is a man to the waift, and from thence downward an horfe. He is reprefented in a pofture of walking, and has in his right hand a fpear, in the left he holds a wolf by the fore paw, and is piercing it with the weapon in the other; but the Wolf is properly another conftellation, and will be defcribed in its place, and under the article Lupus. The figure, allowing for the natural monftroufnefs of joining the human and the beftial form, is well drawn, and appears as in other delineations of the Centaur.

The conftellations, between and among which the Centaur is placed, are the Scorpion, the Hydra, the Royal Oak, the Southern Triangle, and the Altar. The Scorpion is ftrait before him, and the head of the Wolf, which he holds in his hand, touches, or nearly touches, the claws of that animal. The tail of the Hydra is juft over the head of the Centaur, the Royal Oak is clofe behind him, the Southern Triangle is under his feet, and the Altar at a little diftance below them.

The antient aftronomers counted thirty-feven ftars in this conftellation; Ptolemy fets down that number, and he doubtlefs took it from Hipparchus; Flamftead allows only thirty-five. Of thefe there is not one of the firft magnitude, but there is one of the fecond, which makes a very confpicuous appearance; it is in his fhoulder. Some have wanted to reduce the character of this ftar to that of a third in magnitude, but it is truly and properly a fecond. There are fome other very bright and fair ones, though of fmaller magnitude, and they are difpofed very happily. There is one in the hoof of the left fore foot, and another in the right leg, about four very confpicuous ones in the body, and four very happily difpofed in the face; fo that, upon the whole, the figure is extremely well defined, and confequently eafy to be diftinguifhed in the heavens.

A figure, part man, part horfe, might very eafily have its ufe in the hieroglyphics of the Egyptians, and it is very probable, that thence was its true origin. The delineation being one in ufe, on other occafions might eafily be removed into the heavens; and it is moft probable, that although we do not know the original meaning of the form, this was its introduction into the fphere.

The Greeks, however, who firft received aftronomy from Egypt, thought, that as they were to fpread it through the reft of the world, they might claim its invention; with this defign they adapted fome part of their hiftory to every one of the celeftial figns. They tell us, that this Centaur was the famous Chiron, the moft honourable of that form, and that he was for his virtues raifed to a place in the heavens. They fay, he was the fon of Saturn and Philyra; that he excelled not only the reft of the Centaurs, but all mankind in juftice and in wifdom, and was the tutor and educator of Æfculapius and Achilles. They add, that he perifhed by an arrow of Hercules, but that it was by accident, though they do not agree what the accident was. Some fay, as they were converfing together, he dropped one on his foot; others, that, wondering how fuch little weapons could do fuch execution, he had taken up the bow, and was fitting one to it, but being unaccoftmed to thofe arms, that it fell and killed him by a wound in the foot; for they all agree that the hurt was received there. Jupiter, they fay, taking compaffion on him for his untimely fate, took him up into the heavens, where his figure is feen over an altar, with a beaft in his hand, which, they fay, he is about to facrifice. This is the general ftory of the Centaur, as

delivered by the mythologists; but as there have been more Centaurs beside Chiron, they are not all perfectly agreed about which of the family this was. Several of the old writers among them say, it is Phales the Centaur, famous for divination, and they suppose him represented with a victim in his hand, and about to offer it at the altar, to convey an idea of his usual way of prophesying future events. The Greeks would have obtained more credit in general for their stories, if they had kept always in the same, but when they disagreed with one another, few could be inclined to believe any of them.

Schiller, who has banished all the old constellations out of the heavens, calls the stars, of which the Centaur is formed, Abraham and Isaac.

CENTRE *of a Circle*. The point from which the circle is drawn. This is exactly in the middle of the figure, and at the same distance from all parts of its circumference; if the circle be drawn by a line fastened at one end, this is the place where it is so fastened; if by a pair of compasses, it is the point in which the fixed foot of the instrument is placed, while the other performs the revolution.

CEPHEUS. One of the constellations of the northern hemisphere, and a very considerable one. Cepheus is one of the forty-eight old asterisms, and is mentioned by all the writers of astronomy. It is a very large constellation, extending several ways to a considerable breadth, but it does not comprehend a great number of stars.

It is the figure of a man standing in a firm posture, with his legs at a distance from one another, and his arms extended; having a crown upon his head, a scepter in his left hand, and in his right holding up a part of a garment, which falls over the lower part of his body. The other constellations which surround Cepheus are the Serpent, the Little Bear, the Camelopardal, Cassiopeia, the Lizard, and the Swan. His back is toward the Serpent, his face toward Cassiopeia, his right foot comes just upon the origin of the Bear's tail, the Swan is behind his shoulders, and the Lizard over his head.

The antients counted but thirteen stars in this large constellation. Ptolemy's catalogue allows it no more; Hevelius gives it fifty-one; but Flamstead reduces the number to thirty-five. There is one of these amongst the rays of his crown, several about the head, one at the top of the scepter, two or three in each arm, several upon the body, one on each knee, and a large one toward the lower part of the left leg.

The Greeks tells us, that this Cepheus was a king of Ethiopia, and the father of Andromeda, the princess who was delivered up to be devoured by a sea monster, and whom Perseus rescued. The lady and the hero have their place among the constellations to commemorate the fact, and the historians have removed the father also thither, as a reward for his piety. Cassiopeia, for she was the mother of the lady, had brought this mischief on her family and country, they tell us, by her vanity and pride in her beauty; but she also is got up into the heavens, and, in the figures of the constellations, Cepheus is painted with his eyes directed toward her.

Among the nick-named constellations Cepheus makes a very considerable figure. He is made by some of the enthuasists, who have given rise to that custom, the first of martyrs, and by some the wisest of men. Hartsdorf, who always has recourse to the Old Testament on these occasions, calls it Solomon; but Schiller, whose zeal is all devoted

voted to the new, makes it St. Stephen. But these are foolish innovations; they would make a great deal of confusion in the science, if any body regarded them, but no one does.

CERBERUS. One of the new constellations formed by Hevelius out of the unformed stars, and added to the forty-eight old asterisms. This contains only four stars.

CERES. A name which some of the old astronomers have called the constellation Virgo. The Egyptians, who devised the figure, gave it no wings, they meant by it only a harvest-working-woman. The ear of corn in her hand denoted this, but that ear has made her be taken for Ceres. *See* VIRGO.

CERUCION. A name by which some, who love uncommon words, have called the constellation Corona Australis. It is a Greek name, and signifies the same with Caduceus; that being one of those figures under which the sign was originally represented.

CETEUS. A name by which some old authors have called the constellation, which Ptolemy only has named Engonasin, a man on his knees, and which the Greeks have called Hercules. Those who call it Ceteus, say, he was a brother of Lycaon, king of Arcadia, and that the nymph, transformed into the Great Bear, was not Callisto, that monarch's daughter, but Megisto Ceteus.

CETUS, *the Whale*. One of the constellations of the northern hemisphere, but at a considerable distance from the pole. It is one of the old forty-eight which the Greeks received from the Egyptians, and which they afterwards taught to the rest of the world. It is an enormously large constellation, one of the greatest indeed in the whole heavens, but in proportion to its extent it contains fewer stars than most others.

Many of the animals of the heavens are very unlike to all that are upon the earth, and this is one of them. The figure under which we always see it represented in the schemes of the constellations, being like no creature in the animal world. At first sight it hath a great deal of resemblance to the Ægipan, whose figure is called Capricorn among the signs of the zodiac; having, like that, two legs before, and the tail twisted and turned up. It is a monster with the head, neck, and shoulders very like the quadrupede kinds; what there is of fish about it is from the shoulders to the tail, and there it has less than Capricorn, that creature having fins at the sides, which this wants. The posture of this is also somewhat like that of Capricorn. The head is figured very large and of a strange form, the mouth like that of a lion, and armed with terrible teeth, the neck is thick and short, the breast large and prominent; from the anterior part of it there grow two very thick legs, with feet at the extremities, which are broad, webbed, and have long and sharp claws. The body, from this part, grows smaller, and is terminated by a broad tail; but this is vertical as in the generality of fishes, and not horizontal as in the whale. It is a thing, perhaps, unobserved by painters, but naturalists know, that the whole cetaceous kind, or all the fishes belonging to the whale class, have the tail growing cross-wise to the body.

The constellations, that are about the Whale, are Taurus, Aries, Pisces, and Eridanus. The Bull is at a little distance above and before him; Aries is almost directly over his head, The knot in the line, which connects the two fishes, is very near the hinder part of his neck, and the river Eridanus pours itself down

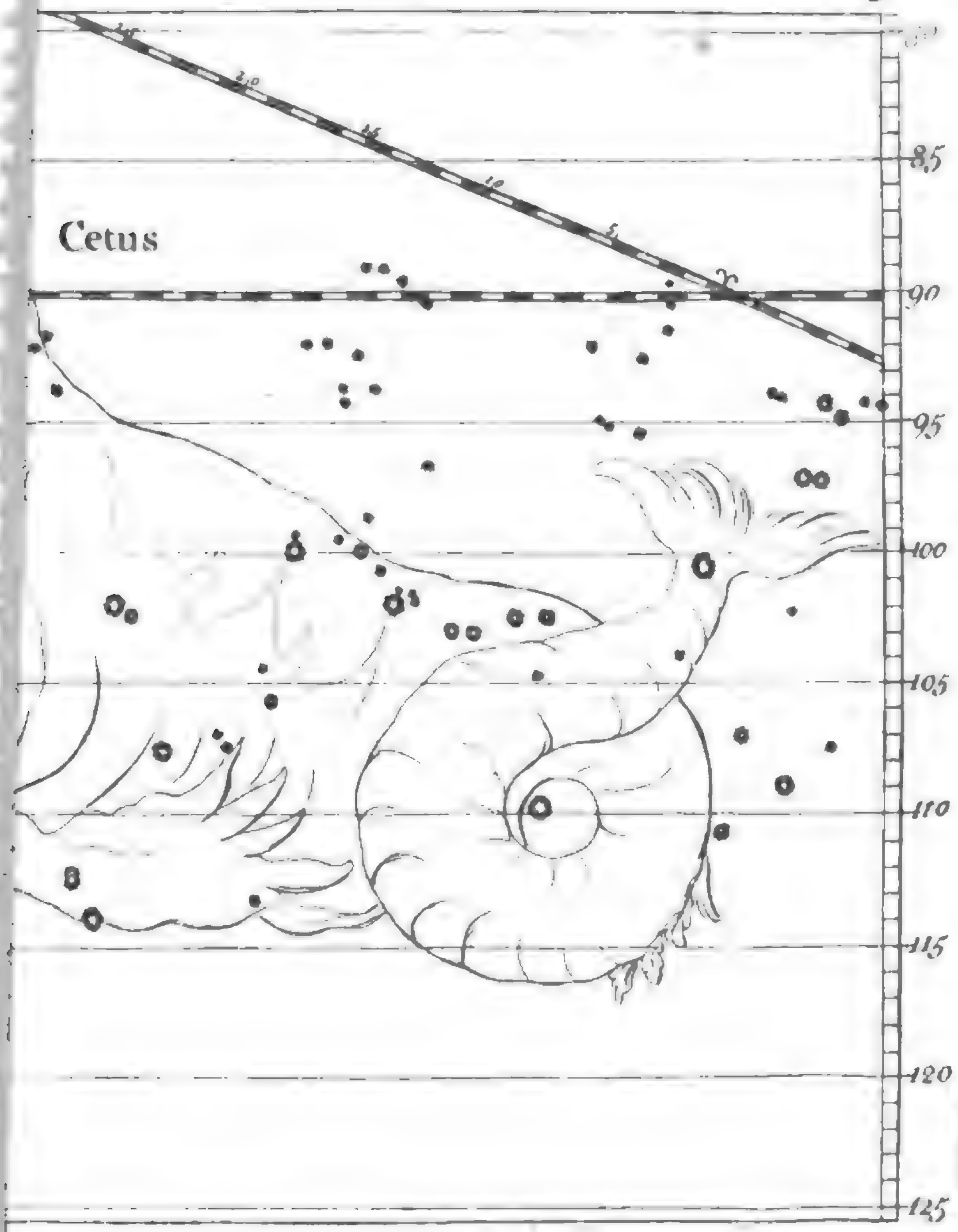
on a level with his breaft, and under his two feet.

The antients counted, in the conftellation Cetus, no more than twenty-two ftars. Ptolemy fets down that number, and we know he was a clofe copier of Hipparchus, the firft man, fo far as we know from the earlieft hiftory, who made a catalogue of the ftars. Tycho Brahe fets down only twenty-one. Hevelius, inftead of diminifhing the old number, more than doubles it; he makes the ftars of Cetus forty-five, and our Flamftead raifes it up to ninety-feven. Yet even this largeft account is not great in proportion to the fpace which the conftellation occupies in the heavens. Aquarius is lefs, and the ftars in him are an hundred and eight; and Pifces are much lefs, and in that conftellation there are one hundred and thirteen ftars, according to Flamftead's own account.

Among the ftars of the Whale there is not one of the firft, and there is only one of the fecond magnitude; this is in the jaw. The ftars of the third magnitude are fix. There are alfo two or three others, which fome make of the third, and others of the fourth; and among the fix one is difputed whether it be of the third, or of the fecond. This, which, next to the ftar of the mouth, is doubtlefs the largeft in the conftellation, is in the neck, and it is a very remarkable ftar. We are not to wonder that authors, who wrote at different times, have not agreed about the bignefs of it, for its apparent bignefs is not at all times the fame. It is one of thofe called re-apparent ftars, and is of the nature of what have been called new ftars by the lefs perfect in the fcience. All the heavenly bodies, fo far as we are able to difcover, have a revolution round their own axis. The fun, we know, has fuch a motion; and, as we underftand the fixed ftars to be fo many funs, we cannot but conceive them to have the fame. The greater part of thefe are luminous all over their fuperficies, but it feems as if there were fome luminous only in part. As thefe turn the opake fide to us, they will be invifible, as the bright part is more expofed to us they will be vifible, and they will appear larger in proportion. This feems to be the cafe with all the re-apparent ftars, but it is in none fo probable as in this of the neck of the Whale, not only the changes of its magnitude, but the periods of thofe changes, and times of the greateft and leaft fize, have been calculated with fome degree of regularity, though not perfectly fixed and invariable.

Of the other ftars of the third magnitude in Cetus, one is in the tail, another in the pofterior part of the body, a third near to that, a fourth nearly in the middle of the body, a fifth in the mouth toward the cheek, and the fixth in the hinder part alfo of the body.

The Whale, as we generally term it, deferves another name according to the accounts which the Greeks give of its origin. That it is a monfter appears fufficiently by the figure of it, and their ftory makes it one; they fay it was the fea-beaft fent by Neptune to devour Andromeda, and killed by the moft mighty Perfeus. Jupiter, they tell us, to confole the fea-god on its deftruction, and at the fame time to do honour to the conqueror, immortalifed the conflict by taking the flain creature up into the fkies. What the Egyptians, who were probably the authors of the conftellation, mean to have underftood by the creature, is not eafy to fay: we fhould firft know whether what we fee was the true figure. The Greeks were fond of adding to the conftellations fome little part, that, while it made no confufion in the heavens, made the figure agree with their ftory. The fword of Perfeus, and the fetters of Andromeda, are of this origin, and very probably



Cetus.

probably the feet of this creature. The Egyptians might give the figure of a plain whale, these feet have made a monster of it; and, while they adapt it to the fable of these fantastical writers, have taken in no stars that belong to any other constellation. They cover a part of the Eridanus, but there is not a star of any consequence in the part of it so covered. As to a couple that are at the insertion of the legs, it is only supposing the out-line of the body continued a little lower, and they will fall within it.

The enthusiasts, who have been for new-modelling the heavens, have not omitted this constellation. Schickard leaves the figure as it was, but, instead of calling it the monster that was to eat up Andromeda, he desires it may be named Jonas's Whale. Schiller, who is more violent in his changes, makes a new constellation of it, under the name of Joachim and Anna.

CHABAN. A name by which some, who love hard words, call the planet Venus. 'Tis one of the Arabic names of that planet, and signifies great.

CHAM. A name by which some have called the constellation Taurus. The Egyptians suppose it to have been a representation of Nizzaim, their Osiris, who was the son of Cham, and who taught the Egyptians tillage. They often gave the father's name for the son's.

CHAMAH. A name by which some, who are fond of uncommon words, call the sun. It is one of the Hebrew names of that luminary, and signifies, properly, heat.

CHAMELION. One of the new constellations of the southern hemisphere, at no very great distance from the pole. It is not a large one, nor does it contain a quantity of stars that is more than proportioned to its extent.

It is represented tolerably well in figure of the animal, by whose name it is called; and, indeed, the stars do, in some measure, correspond with that figure. The new-formed constellations are, in general, better designed than the old, and that for two reasons. The one, that those, who have given origin to them, had more knowledge of nature, and were better able to draw the figures of her creatures, as she had made them. The other, that they contrived to select such figures as best answered to the disposition of the stars in the heavens, as they had no other consideration; whereas the antients meant, by their figures, to convey some meaning as in mythological writing, and therefore fixed upon such an animal as answered that meaning, and then adapted the stars to its several parts as well as they could. Thus the moderns, when they fixed upon a Chamelion for the creature under whose form to delineate this constellation (because the disposition and situation of those stars, with respect to one another, resembled, in some degree, the form of that creature) had nothing to do but to draw the animal in their schemes as like to what it was in nature as they could: whereas, when the antients had fixed upon the Bear, for its slow motion, to comprehend the stars about the pole, they made no scruple of adding a long tail to the animal, though nature had not done so, in order to make it comprehend the stars that belonged to the number they meant to mention.

The constellations, between and among which the Chamelion is placed, are the Flying Fish, the Royal Oak, the Bird of Paradise, and the Bee. The Flying Fish has its side and two of its fins toward the crooked tail of the Chamelion, and, at a little distance, the Royal Oak has the bottom of its trunk just by the tail;

tail; and this in respect of this figure, is placed, not on its feet, but with the belly upwards. The back part of the head of the Chamelion comes to the tail of the Bird of Paradise; and the Bear, which is just under the feet of the Centaur, has its hinder part immediately over the head of the Chamelion.

The stars, of which this constellation is composed, are ten, and it has already been observed, that they are happily distributed over the body. The principal of them are two upon the anterior part of the body toward the shoulder, two others on the posterior part of the body, the one near the back, and the other on the thigh, and four following one another very happily along the tail. Two of these in the middle are very near to one another, and the hindermost does not reach so far as the curled or twisted part of the tail, that being the fancy of the painter, or made to help out the figure. It is necessary to the Chamelion, but it cannot be said that it is necessary to the constellation.

CHANGEABLE STARS. Certain fixed stars, which are seen at sometimes, and are not seen at others, and which, during their appearance, diminish or encrease in apparent magnitude and brightness; they are called also reapparent stars. *See* NEW STARS.

CHARA. A name given by some to a constellation, or a part of a constellation, of the northern hemisphere. This and Asterion are the two greyhounds, or, as some call them, hounds, that are held by Bootes, and seem pursuing the Great Bear. This is one of the constellations added by Hevelius to the forty-eight old ones, and designed out of the unformed stars. *See* CANES VENATICI.

CHARLES WAIN. A name by which some of the astronomical writers, in our own language, have called the Lesser Bear. The two Bears have been called two Waggons or Wains, and by the Latins, who have followed the Arabians, two Biers, Feretrum Majus and Minus. *See* URSA MINOR.

CHASARA TSAMAGANDU. A term by which those, who will go very far for a hard long wood or two, have called the Milky Way, or Via Lactea, in the heavens. The plain sense of the term is, not the Way of Milky, but the Way of Straw, and it is the Ethiopian name for that appearance in the heavens. Most of the Eastern nations have, in like manner, called it by a name in their language, signifying, like this, the Way of Straw. The occasion is, that as the Greek fable derives the colour and brightness of this part of the heavens from milk spilt from the nippel of Juno, the Egyptian mythology, which is every whit as extravagant as the Greeks, deduces it from some heaps of burning straw, which their goddess Isis threw behind her, from time to time, as she was pursued by the terrible giant Typhon.

CHELÆ SCORPIONIS. A name by which some express the stars in Libra. The Scorpion originally occupied two divisions of the zodiac, and his claws, which extended into one of them, have been since cut off to make way for the constellation Libra. *See this farther explained under the article* FORCEPS.

CHELE NOTIOS. A name given by the Greek astronomers to a conspicuous star in Libra. *See* LIBRA.

CHELIDONIAS. A name by which some of the old writers have called one of the two fish, which together form the constellation Pisces. It is the northern fish which is called by

by this peculiar name, and it is a very old denomination for it. The Chaldeans represented this fish with the head of a swallow. It was a coarse way of expressing, that the swallow, which is a bird of passage there as well as in England, first came thither at the time of the rising of that constellation. This was the occasion of the peculiar figure, and Chelidon being the name of the Swallow, the denomination of the fish, which had the head of that bird, from it, was easy.

CHELEUB, or CHELUB. A name by which some have called Perseus. It is one of the Arabic names of that constellation; they call it also Bashaush.

CHEREJENGH. A name by which the astrologers, and some of the astronomers, who love hard words, have called the constellation Cancer. It is its Persian name.

CHETIL. A name by which some call that part of the constellation Pisces, which consists of the band or fillet which ties the two fishes to one another. It is the Arabian name of this part of the constellation, and expresses a Tape. The Greeks call it Lirion.

CHETZ. A name by which some, who are fond of hard words, call the Arrow. It is the Hebrew name of that constellation; the word signifies an Arrow.

CHILEA. A name by which some, who are fond of hard words, have called the constellation Corvus. It is one of its Arabic names, they call it Al Chiba, the Raven.

CHIMAH. A word used by some of the old writers as the name of a constellation, and by them understood to signify the Pleiades. This is an error, but it is a deep-rooted one, and it is easily accounted for. Chimah is used in the Hebrew bible as the name of a constellation. It is mentioned in Job, in Isaiah, and in Amos, and, being joined with another word Chesil, it is, with that, in all the versions, rendered the Pleiades and Orion, or the Seven Stars and Orion. The commentators say that it is the same with the Al Thuraiya of the Arabians, which is indeed a name of the Pleiades, but it is not the same with that. Whether the word Chesil signified the Pleiades, or not, is another consideration; but Chimah certainly was not the name of that constellation, but of Orion. In its very signification it means giant, a name by which the Egyptians probably called Orion, for the adding the names of particular persons to the constellations was an after-trick of the Greeks, who had an ambition to be thought the inventors of that science which they taught the rest of the world; and thought they could no way so well answer this purpose, as by making the figures in the heavens be understood as representations of their history. In the same manner that figure in the heavens, which they call Orion, they received from the Egyptians, with a name only expressing a man, a warrior of an enormous size.

The translators of the bible were right, as has been observed, in guessing one of the two words Chimah and Chesil to be the name of the very constellation which the Greeks called Orion. They had enough to lead them into the error which they have made in fixing upon the wrong, and they do not want a kind of justification afterwards. We find the old astronomers, in general, alledging, that Chimah is the same with the Al Thuraiya of the Arabians, and the Althuraiya is the Pleiades. Thus we see many of different periods expressing themselves; but if we would understand the truth we are not to

seek

feek it in tranflations, or commentaries, but in the original. There is a great deal of difficulty in making out the meaning of words by the etymology in thefe languages, but it is to be done. We find the conftellation Orion to be of Egyptian origin, we find its form to be that of a man of enormous fize, and we find it referred to by the old writers of that nation. We find a conftellation, among the few that are named in the bible, often referred to, alfo by the name of Chimah, and we find the original fignification of the word Chimah to be a giant. The Arabians of moft credit have tranflated it into their language by the word Al Gabbar, which fignifies alfo in that tongue a giant. It is not probable, that the Egyptians meant to exprefs the refemblance of any peculiar perfon by this enormous figure, they meant it only as a giant; and as they muft have fome name for it, what is fo likely as that they fhould call it a giant. This name was moft probably the original one, and this was continued to the conftellation in the languages of all the people who received it, except the Greeks, who being defirous of having it fuppofed invented among them, affixed to it the name of their Orion. To this vanity of theirs we therefore owe all this perplexity and error. The tranflators of the bible were right in their conjecture, that Chimah and Chefil fignified fome other conftellation than Orion; but if inftead of Orion the Greeks had continued the fimple name of the giant, it might have led them to the etymology of the word Chimah, and they would have given undoubtedly that word to that of the two conftellations. We very well know the genius of the oriental languages runs out into fubordinate fenfes of the fame word, and thefe very often feem, unlefs to thofe who can purfue the chain of the fenfe, to loofe fight of the original word. Thus, in the prefent cafe, if Chimah fignified a giant, it would alfo fignify a warrior, becaufe giants are fuppofed to be men of prowefs, and from this a man in armour, or a man in the act or pofture of fighting, will alfo be expreffed by it, whether he be a giant or not. We know the affinity of the feveral oriental languages alfo, and we fhall mind that in the Arabic Chamai fignifies to *gird the fword upon the thigh*, as the fcripture expreffes it, or to put on armour. Thus we fhall fee that the fenfe of the word Chimah, which in the Hebrew bible is the certain name of a conftellation, is a giant, or a man in armour, and by which ever of thefe names we fhall be guided, there is no conftellation to which we fhall refer the word Chimah fo readily, as to that which the Greeks call Orion.

That Chimah and Chefil therefore fignify, as they are tranflated, Orion, and the Pleiades, may be too much to affert; for the word Chefil does not feem fo determinate in its fignification as the other. But this is to be allowed as a certainty, that Orion, as it is now called, is one of the two conftellations fo named together; and that not the word Chefil, as has been thought, is the name of it, but Chimah, that word, which has been fuppofed to exprefs the Pleiades, and to be the fame with the Althuraiya of the Arabians.

CHIMO. A name by which fome, who love to write obfcurely, call the conftellation Pleiades; it is a Syriac name. The Perfians call them Peru, and the Tartars Ulgher.

CHIRON. A name given by fome of the old writers to the conftellation, generally called the Centaur. The Greeks tell us, that it was this peculiar Centaur, who was for his wifdom and piety honoured with a place in the heavens, and they fuppofe him placed over the

the altar in a posture of sacrificing to Jupiter, and call the Wolf in his hand the victim. This creature, it is to be observed, they have not all called a Wolf, some express it only by the name Fera. *See* CENTAURUS.

CHOTEB. A name by which some, who love uncommon words, have called the planet Mercury. It is one of the Hebrew names of that planet, and signifies an attendant or servant who is always nearest to his master; possibly they might give it to this planet, because of his constant nearness to the sun.

CHRIST'S CROSS. A name given by Schiller to a constellation in the southern hemisphere, which he had formed out of the stars, composing the southern triangle, or Triangulum Australe.

CHRISTUS. A name by which Schiller, and his followers, express the sun. These writers, after they had cleared the heavens of all the Pagan constellations, placing Christian stories and figures in their room, began to nickname the sun, moon, and planets. Thus Christ is the name of the Sun, the Virgin Mary is the Moon; and they call Saturn Adam, Jupiter Moses, Mars Joshua, Venus has with them the name of St. John Baptist, and Mercury is Elias.

CHRULIUS. A name by which some, who love hard words, have called the bright star in the stern of Argo, generally called Canopus; this is its Coptic name. The word originally signifies gold.

CHRYSOMALLUS. A name by which some of the old astronomical writers call the constellation Aries.

CHRYSOPHRIS. A name which some, who will have new names, and hard names, for every thing, have invented for the constellation Dorado, as some, or as others, call it the Xyphias, the Sword-Fish, though as the figures express it the Saw-Fish. This Chrysophris is a new name, and there is affectation in calling in the Greek upon such an occasion, since the people who spoke, or who wrote, in that language, could know nothing of a constellation that was not formed till so long after their time.

CHUSHEE. A name by which some people have called the constellation Virgo. It is properly the Persian name for one of the stars of that constellation, the large one which is in the ear of corn in the hands of Virgo, and which is called Spica Virginis, but it is used for the whole constellation also in that language. *See the article* VIRGO.

CICONIA, *the Stork*. One of the Arabian constellations. They were not permitted by their law to draw human figures, so they have put this into the place of Ophiucus, a mule into that of Auriga, and so of the rest.

CIENGH RUMI. A name by which some, who are fond of uncommon terms, call the constellation Lyra, or sometimes the bright star alone in that constellation, which is called Lucida Lyræ. This is a Persian name, properly given to the whole constellation. It means Lyra Græca, the Grecian Harp.

CINGULUM, *the Belt*. A name given by several of the Latin authors to the zodiac.

CIRCLE, *its Area*. To find the area of a circle is to square the circle. This celebrated problem will be solved when we shall find any rectilinear plane figure, be it a square, a triangle, or whatsoever, that is equal to the circle, because the area of any such figure is easily found,

and

and that of the circle, when ſuch a figure is found juſt equal to the circle, is the ſame with its area. But although this has not been done, nor will be perhaps perfectly, we come near enough to anſwer all the uſeful purpoſes; the reſt is ſpeculation.

The area of any circle is exactly equal to the area of a right-angled triangle, which has one of its legs equal to the radius or ſemidiameter of that circle, and the other leg equal to the circumference. This ſeems to bring it to a concluſion; but there is a latent difficulty, which, although not ſeen by thoſe who have not ſtudied geometry, is plain enough to thoſe who have. The difficulty is, to find a ſtrait line equal to the circumference of a circle, the radius being given; or (for that is the ſame thing) to find the ratio between the diameter and the circumference. All the geometricians in the world have attempted this, but it is in vain to expect to perform it perfectly. We can come as near to the doing it exactly as we pleaſe, but we never ſhall do it exactly.

The general calculation is, that the diameter of a circle is to the circumference as one to three, and this does in the groſs very well, being near enough to the truth for ordinary purpoſes; but it is not the truth. It was very early improved ſo far as to give the diameter to the circumference as ſeven to ſeventy-two, and from that time men of ſcience have, by calculation, brought it nearer and nearer to the truth, but ſtill only near. They have not reached it, but they come as near to the truth as will be neceſſary to the aſtronomer. We may take it as a maxim, that the diameter of a circle is to its circumference as one thouſand is to three thouſand one hundred and forty-one; and though we know this not to be the truth, yet we may very well anſwer all ordinary purpoſes by it.

According to this, when the diameter of a circle is given, we can find its circumference by the golden rule; or, on the contrary, the circumference being given, we can find the diameter, and, to all neceſſary purpoſes, we can thus ſquare the circle, or find its area, although we cannot do it in the ſtrict and ſcrutinous eye of calculation; for the diameter and the circumference of a circle being thus found, half the diameter is to be multiplied by half the circumference, and the product will be the area of the circle. Thus is this problem, which puzzles all the world in theory, ſolved ſufficiently for all uſes of practiſe.

Circle, *great of the Sphere.* If we ſuppoſe a ſphere, turned round upon its axis, a point which is at equal diſtance from both poles, or, in other words, from either extremity of that axis, it will, in its revolution, deſcribe a circle round the middle of the ſphere. This circle cuts the ſphere into two equal halves, and, being the largeſt that can be drawn upon that ſphere, it is called the great circle, or a great circle of that ſphere. *See the article* Sphere.

Circles *inclined.* Circles, of whatſoever diameters, which are drawn from the ſame centre on two inclined planes, their inclination has the ſame angle with that of the planes. *See* Plane.

Circles *parallel.* Circles of whatſoever, equal or unequal, diameters, which are drawn from the ſame centre upon parallel planes. *See* Plane.

Circles *perpendicular.* Two circles drawn from the ſame centre on planes, which ſtand perpendicular to one another. *See the article* Plane.

Circles *of the Sphere*. In reading the antient aſtronomy, it is neceſſary to underſtand, that thoſe authors attributed a particular ſphere, or, as they ſometimes called it, an appropriated heaven, to every planet, and to the other ſtars. Every planet had its heaven, the ſun among the reſt, for they ſuppoſed it moved; and above all, the fixt ſtars, in a body; theſe they ſuppoſed were all fixed, in what they called the eighth heaven: this they called alſo the firmament, from an opinion of its great ſtability. This firmament, or eighth heaven, they ſuppoſed was carried about from eaſt to weſt every four and twenty hours, by what they called the Primum Mobile, and this, they ſuppoſed, made the daily revolution of the fixed ſtars about the earth. Nothing can be ſo natural an error as this, though nothing is ſo contrary to truth; but when the firſt principle is falſe, there is no end to error in deductions. Thoſe who had eſtabliſhed it as a certainty, that the earth ſtood ſtill, might eaſily ſuppoſe the ſphere, or heaven of the fixed ſtars, to move; otherwiſe they could give no account of appearances.

This motion of the firmament is ſuppoſed to be made round about two fixed points in the heavens, theſe are placed oppoſite to one another, and theſe are called the poles of the world; that which is near the Great Bear is called the north pole, that which was called the ſouth pole is directly oppoſite to it. The line joining theſe two poles is the axis of the world. This is ſuppoſed to paſs through the centre of the earth, and to mark upon its circumference two poles anſwering to thoſe in the heavens; theſe are therefore the poles of the earth. The great circle of the ſphere, or that which is at equal diſtance from the poles, in other words a circle, ſuppoſed to be marked round the ſphere by the revolution of any one point, which is at equal diſtance from each pole, is called the equator; and the plane of this circle, paſſing through the centre of the earth, determines, on its circumference, a great circle, which is at equal diſtance alſo from its north and ſouth pole; and this is alſo the equator, or the equinoctial, becauſe the the inhabitants of that part of the globe, which falls within it, have the days and nights all equal throughout the year.

This circle, called the equator, is divided, as all other circles of the ſphere are, into three hundred and ſixty parts, or degrees, and theſe are each divided into ſixty minutes, each of thoſe into ſixty ſeconds, and each ſecond into ſixty thirds, according to the eſtabliſhed diviſion.

Thoſe circles, which the ſtars appear to make round about the pole by their diurnal revolution, are called parallels to the equator, or they are ſingly named parallels, and this at whatſoever diſtance they are placed from either pole. The parallels, which aſtronomers mark at about twenty-three degrees from each pole, are called polar circles; and thoſe circles, which are placed on each ſide at an equal diſtance with this from the equator, are called the tropics. That which is placed toward the north is named the tropic of Cancer, that which is toward the ſouth the tropic of Capricorn.

All the great circles of the ſphere, which paſs through the two poles, are called circles of declination, becauſe it is upon theſe that we count the diſtance of ſtars from the equator, this being called their declination; it is the complement of their diſtance from the pole. That circle of declination which paſſes through the pole, and that point of the heavens which is directly over our heads, is called the meridian; and in this circle are placed the zenith and the nadir; the zenith is the point immediately over our heads, and the nadir is the point directly under our feet.

The only viſible circle, among all that we conceive in the ſphere, is the horizon, called, by way of diſtinction, the ſenſible horizon. The occaſion of this term is to diſtinguiſh it from the rational horizon. This rational horizon is a great circle of the ſphere, which is parallel to the other, and which is ſuppoſed to paſs through the centre of the earth. This ſenſible horizon, which is what we uſually underſtand when the term horizon is uſed, is that which ſimply paſſes round the earth. The circle already mentioned, and called the meridian, ſeparates, in its paſſage, the horizon into two equal halves. Of theſe two equal parts, diſtinguiſhed by this diviſion, that in which all the ſtars ſeem to riſe is called the eaſt, and that in which they ſeem to ſet is called the weſt. That point of the horizon which is placed exactly at its interſection with the meridian, neareſt the north pole, is called the north point, and that which is neareſt to the ſouth pole, is called the ſouth point: and thoſe two points on the horizon, which are at equal diſtance from the north and ſouth points, are called, according to that part of the horizon in which they are ſituated, the one the eaſt point, and the other the weſt point. The arc of the horizon, which is contained between the eaſt point, and the place where a ſtar riſes, is called the amplitude. And, on the other hand, the diſtance between the place of a ſtar's ſetting and the weſt point, is called the ſetting amplitude.

Thoſe great circles of the ſphere which paſs through the zenith and nadir, and divide the horizon into two parts diametrically oppoſite, are called vertical circles. And of theſe, that which paſſes through the eaſt point, and the weſt point, is called the firſt vertical. This cuts, at right angles, that other vertical circle, which, in the ſame manner, paſſes through the ſouth and north points, and which, by that means, confounds itſelf with the meridian. It is upon theſe vertical circles that aſtronomers meaſure the apparent height of the ſtars above the horizon, the greateſt of theſe is always that which is taken on the meridian.

The circles parallel to the horizon, which terminate the height of thoſe ſtars, are called Almicantars. The equator cuts, or interſects, the rational horizon at two points, eaſt and weſt, and it appears differently elevated above the horizon in different parts of the earth, and this in proportion as they are nearer to, or farther from, the poles. Thoſe, who live under the equinoctial, ſee it perpendicular to the horizon, and, as they are removed farther from that circle, it is more and more inclined to the horizon, till, at the poles, it is hid under the horizon.

The parallels to the equator, which the ſtars ſeem to deſcribe by their diurnal revolution from eaſt to weſt, are, in the ſame manner, differently inclined to the horizon, according to the different parts of the earth from which they are viewed. Thoſe, who live in the equinoctial, ſee them, as they ſee the equator, perpendicular to the horizon, and, in the ſame manner, they are divided by that horizon into two equal parts. It is this that renders, in every diurnal revolution, the time in which thoſe ſtars appear above the horizon exactly equal to that which they are under it, and conſequently render their day and night, throughout the year, exactly of equal length. From this place of view theſe parallels are divided by the horizon into unequal parts, in proportion as they are viewed from parts of the ſurface of the earth more and more diſtant from this equinoctial, that is, more and more approaching to the poles. This is what cauſes the inequality of days and nights in theſe places. This inequality increaſes, according to the diſtance from the equinoctial to the polar circle, where

thoſe,

those, who inhabit them, see the sun appear in the time of the solstices the whole day without ever setting, or descending below the horizon; and, on the contrary, it remains afterwards the whole period of the day beneath the horizon, without appearing or rising at all, and this for the plainest reason in the world, because the parallels, which the sun there describes, touch the horizon without any where intersecting it. This presence and absence of the sun increases and diminishes by degrees as the approach is made from the pole itself to the polar circle, or from the polar circle to the pole; whereas the pole itself of the circle, which the sun describes, being absolutely parallel to the horizon, that luminary is six months of the year without setting, and six months without rising; so that the year at the pole consists only of one day and one night, the day continuing six months, and the night six.

That great circle of the sphere, about which the sun performs his annual revolution, is called the ecliptic. This is supposed placed in the middle of a great girdle or band, of about sixteen degrees in breadth, which band or girdle, is called the zodiac. This zodiac is divided into twelve equal parts, each containing thirty degrees, and each called by the name of a sign. These signs are the signs of the zodiac, and these answer to twelve constellations to which they owe their names. These are Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius, Pisces. The ecliptic is enclined about twenty-three degrees twenty-nine minutes to the equator, and in its passage cuts or intersects it at two points, which are equally opposite to one another; one of these points, which is that in which the sun is found in the time of the vernal equinox, is called the point of Aries, and the other, in which the sun is seen in the autumnal equinox, is called the point of Libra. This circle is terminated on the two sides by the tropics of Cancer and Capricorn, which touch it in two points at the distance of ninety degrees on the one part, and on the other from the point of Aries, and the point of Libra. The ecliptic has its two poles, which are twenty-three degrees and twenty-nine minutes distant from the poles of the equator, and which consequently are within the polar circles.

That meridian, or that circle of declination, which passes through the poles of the equator, and that of the ecliptic, is called the colure of the solstices; and that circle, which passes through the poles of the ecliptic, and the intersections of the ecliptic with the equator, is called the colure of the equinoxes. These two circles, or colures, cut one another at right angles, and they divide the ecliptic and the equator into two equal parts.

Those great circles of the sphere which pass through the poles of the ecliptic, and through any star, are called circles of latitude, because it is on these circles astronomers measure the distance of such a star from the pole of the ecliptic. The compliment of that measure is the stars latitude.

The distance which is between the point of Aries, and that point of the ecliptic, to which the circle of latitude answers, which passes through the star, as mentioned in the last instance, is called the longitude of such a star, and this is counted from west to east. In the same manner, that is called the right ascension of a star, which is the distance between the point of Aries, and that point of the equator, to which the circle of declination, which passes through that star, answers.

When geographers use the term latitude, they mean by it the distance in degrees of any place on the surface of the earth from the equinoctial, measured upon the meridian of that

that place; this distance is equal to the height of the pole in that place; and when they use the term longitude, they mean by it the distance of any place from the first meridian, measured on the parallel of that place. The position of this first meridian is arbitrary. Some make it pass through the Pike of Teneriffe, others through the isle de Fer, which is the most western of the Canaries. The French in general count from the last place, we from the former.

Geographers have much to consider on this head; but it is sufficient for the astronomer to know the differences of longitude between the place upon the earth's surface, with regard to the meridian for which the tables are calculated, and the different places of the earth, or, as it is otherwise expressed, the differences of meridians. Thus are all the circles of the sphere explained, as to their position and uses, and little more than a remembrance of these explanations is necessary to understand, not only whatsoever is said of the heavenly bodies, in the course of this work, but to read most of the astronomical works of the moderns with ease.

The Greeks lay a claim to very early knowledge in this article, and perhaps if we were inclined to allow them all they assert, we should give it still higher to the Egyptians. Plutarch tells us, that Thales divided the celestial sphere into five circles, which he called zones; the one the arctic, alway in sight, next the summer tropic, then the equinoctial, after this the winter tropic, and then the antartic, never seen by us at all. Plutarch is not the only writer who records this of Thales. Stobæus is another of the authorities quoted by those who believed it. They add, that he said the oblique circle, called the zodiac, lay under the three middle circles, and touched them all; and that they were all cut at right angles by the meridian which goes from pole to pole; but had this been the case, we should have heard more of it; if it were, indeed there would be great reason to suppose it of Egyptian origin, for Egypt was at that time the seat of the sciences. What the Greeks knew of astronomy they obtained thence; and this very Thales is recorded to have travelled thither, and to have been admitted to the greatest intimacy with their priests, who possessed all the knowledge that was amongst them. It is, however, by no means to be supposed, that the Egyptians themselves, much less their pupils, the Greeks, were informed of this in the time of Thales. Parmenides lived fifty years after the death of Thales, who is pretended to have made this discovery; and Strabo tell us, that Parmenides was the first man who planned out the terrestial zones. There is no reason in the world to believe, that the celestial were invented till long afterwards.

Circulus Antiquus. A name that some have given, very oddly, to the Milky Way; but the meaning of the appellation is this. Some of the old philosophers, puzzled in what manner to account for that strange effusion of brightness, and willing to give their fabulous history an air of reality, by referring from it to visible objects, declared, that the sun had, at some time, long before theirs, altered what had been his original course, and that his way through the zodiac was in a manner a new thing. They declared, that it originally lay through the Via Lactea, and that it was owing to the heat he every where diffused about him, that the path he before pursued still retained this colour of an enlightned sky, and that, if he were to leave the zodiac, some portions of it would have the same appearance.

This was the old opinion, how idle it was needs not be observed. They give the origin

of it to Ænopides Chius, but it was received by many of later name. The fabulifts, when they found among the philofophers an opinion of the fun's having changed his courfe, were not wanting to give reafons for it. Some of them faid, it was not an abfolute change, nor did the fun ever regularly move in this path, but that it was the part of the heavens through which Phaeton drove the chariot of his father, and that he was the occafion of the appearance. This opinion Manilius mentions, and gives it as one of the favoured fyftems for accounting for the phænomenon; but others, not fatisfied with an accidental, and, as it were, inftantaneous thing, as an account for an appearance of fo much confequence, and defirous to fall in with the original opinion of an abfolute and regular courfe of the fun, of which this was a part, fay, that as the fun is reported to have refufed to fee the banquet of Thyrftes, it was then that he altered his courfe, and left this mark of his former tract, when he betook himfelf on that occafion to the zodiac. This, as it favoured a famous ftory, was very generally received, and it became almoft a part of their religion to believe it.

Circulus Perpetuæ Apparitionis. A term by which the antient aftronomers expreffed, what they otherwife called, the arctic circle. By thefe names they expreffed the largeft parallel that was to be feen entire above the horizon of any place in north latitude, and they gave it the name of the circle of perpetual appearance, becaufe no part of it was ever hid, and confequently not one of the ftars, that were contained in its compafs, ever fet or funk below the horizon, being all carried perpetually round in circles parallel to the equator, and all to be feen above the horizon, in one part or other of thofe circles, as foon as it was dark enough for them to be vifible.

Circulus Perpetuæ Occultationis. A term we frequently meet with in the writings of the old aftronomers, and which expreffes a circle containing a quantity of ftars which are never feen in the place whence the circle is not feen. They mean by this term the fame with what they, in other places, call the antarctic circle; that is, the largeft parallel which is hid entirely below the horizon of any place in the north latitude. It had the name of the circle of perpetual occultation, becaufe no part of it was ever vifible, and it contained a great number of ftars, no one of which was ever vifible in that place, but all of them were carried round, in their revolution, in circles parallel to the equator, no part of which circles ever appeared above the horizon of that place, and confequently no one of all which ftars was ever feen at any time there. This was alfo called the Circulus Maximus femper Occultarum.

CLIMATE. A term ufed by the antient aftronomers to exprefs a divifion of the earth, which, before the marking down the latitudes of countries in degrees and minutes was in ufe, ferved them for dividing the earth into certain portions in the fame direction, fo as to enable them to fpeak of any particular place with fome degree of certainty, though not with the due precifion. The divifion by climates, though far from equal to ours by the degrees of latitude, yet had its ufe, and that very great, among them.

This difference of climates arifes from the different length of day and night in two places at the fame feafon of the year. And the Latins expreffed the fame thing fometimes by the term inclination of the heavens. It was natural for the earlieft obfervers to remark, for one of the firft things, the diverfity that there was in the fun's rifing and its fetting, and the natural confequence of that in the

the different length of days and nights in different places at the fame feafon. It was foon found, that this difference was proportioned to the diftance of thofe places from the equator, and from this there naturally followed a way of meafuring that diftance by thefe obvious means, and the part of the world, with which they were acquainted, was foon, by this, diftributed into certain divifions, which they called by this name of climates.

A climate, according to this divifion, contained an extent of the furface of the earth, that was comprifed between two parallels remote from one another, by fo much, that the longeft day in the one of thefe parallels differed half an hour from the longeft day in the other. The feveral countries, or feveral parts of a country, contained within the fpace between thefe two parallels, they called a climate, and they became able, by faying in what climate a place was, to give fome idea of its fituation. This anfwered their purporfe, when they fpoke of large places; but when they mentioned a fingle city, or a mountain, or any other fingle object, or when in fearching of part of a larger, they had a mind to be more than ordinary exact, they would fay, that it was in the beginning, in the middle, or in the end of fuch a climate. We find the arrangement of places very imperfect, even, according to their own plan, on this foundation. All about the equator was a fpace with which they had no acquaintance, and about which they gave no fort of concern; they fuppofed thefe countries uninhabitable by reafon of the heat, and they were quite unknown to them; and they confidered them (for they muft know that there were fuch places) as lying in a right fphere, and therefore having nothing to do with their divifion of climates, which were only the product of the obliquity of the fphere.

Properly fpeaking, only the parts which lie directly under the equator, were in this fituation of a right fphere, and had nothing to do with climate according to their divifion; but it is not a wonder, that they fpoke more at large, and gave this fituation to the parts about them, as they were fuch as they had no knowledge of, nor fuppofing them uninhabitable, gave themfelves any trouble about. On this principle of only dividing fuch parts of the globe as they knew fomething of, and fuch as were habitable, into climates, they began with that parallel, in which the length of the day is twelve hours and three quarters, and called this parallel the beginning of the firft climate, and from this they meafured to its middle and its end, and from thence began, what they called, their fecond climate, and fo on. Thefe climates they found it neceffary to name, and they gave them their names very, properly, from fome remarkable place, which they fuppofed to be in the middle, or nearly in the middle, of that climate. Thus among the feven climates, which they propofed to the north of the equator, and to which they made feven alfo on the fouth fide of the equator correfpond, they called the firft the climate of Meroe from the middle of it, being fuppofed to pafs through Meroe; the fecond, for the fame reafon, they called the climate of Syene; and the third the climate of Alexandria; the fourth was the climate of Rhodes; the fifth of Rome, and this was called alfo the climate of the Hellefpont; the fixth was the climate of Boryfthenes, from its middle being fuppofed to pafs through the mouth of that river, and the feventh was the climate of the Riphean mountains, fo called like the reft, becaufe the middle of that climate was fuppofed to pafs over thofe mountains. As to the fouthern climates, they had no opportunities of naming them from the places in their middle, or indeed in any other part of them, for they were countries

tries with which they were wholly unacquainted. But that they might not let them pafs without fome defignation, they ufed the names of the northern climates, in a fecondary fenfe, to exprefs them. They only fuppofed thefe fouthern climates to be feven, like to, or correfponding with, the northern ones, and fo they named them. They called the firft fouthern climate, that which correfponded to the climate of Meroe, the fecond to that of Syene, the third to that of Alexandria, the fourth to that of Rhodes, the fifth to that of Rome, or the Hellefpont, the fixth to that of Boryfthenes, and the feventh that which anfwered to the northern climate of the Riphean mountains.

What is meant by the old phrafes of the beginning and the end of a climate, is very plain from this, but it is not fo with refpect to the middle. This was not a place at equal diftance by meafure from the beginning and from the end, for they took this meafure by time, or, according to the foundation of the original divifion, by the length of day, and not by the diftance. Thus, when they fpeak of the middle of any of their feven climates, they mean, by that term, a place in which the longeft day differs in length exactly a quarter of an hour from that of the beginning, and a quarter of an hour from that of the end of the climate. Thofe, who are not accuftomed to aftronomical obfervations, might fuppofe, at firft fight, that this amounted to the fame thing. But this middle will not be found to divide the climate into two parts of equal meafure; for the part neareft to the equator will be larger than the other; becaufe we find that the farther and farther we go from the equator, the fmaller and fmaller difference of latitude will be fufficient to increafe the length of the longeft day a quarter of an hour, which was their meafure.

The aftronomical, and the ordinary fenfe of the word climate, differ extremely, as well as the defign of the word, in the one and in the other ufe: nay, and there are a thirdfet of perfons, who ufe it in a way different from both, thefe are the geographers. The aftronomical ufe of the divifion of the furface of the globe into climates, is to explain the different apparent motion of the fun, and of other of the heavenly bodies, and to inveftigate the caufe of the differences of day and twilight and night. The geographer chiefly confiders the fituation and place of mountains, lakes, and rivers, in the divifion. And, in the ordinary fenfe of the word, it ftands for difference of heat and cold, and the change of the temperature of the air. What common people mean by another climate, and a different climate, is a place where the air is colder or warmer. This may probably have had its origin in the old divifion, and the antients may have been accuftomed to explain, in few words, the difference between the heats of Egypt, and the cold of the Riphean mountains, by faying, that they were in different climates; becaufe they were in very remote ones. But this does not hold good abfolutely with refpect to the change of climate, nor is the warmer or cooler temperature of the air a neceffary confequence of that change. The difference of half an hour in the longeft day, does not take in fo great a compafs of earth, that between parallel and parallel marked by it there muft be a neceffary alteration in heat and coldnefs: the fpace of many climates may do this, but of a fingle one, it is not a neceffary attendant. For the temperature of the air, in places fo near to one another, is more influenced by the accidents of covert and expofure, than of all thefe; and its heat or cold depend more upon the difference of its being open or fheltered, of its having mountains behind or before it, or being plane, or of its being barren or covered with forrefts. The difference of climates there-

fore may, in a larger ſenſe, be ſuppoſed to correſpond with the temperature of the air, and that thoſe nearer to the equator are hotter, and thoſe nearer to the pole colder. But, if we ſuppoſe the terms are correſpondent, in the ſtricteſt ſenſe, or immediately dependent on one another, we ſhall give them a meaning they will not bear.

CLOUDS *magellanic*. A name, though a very improper one, by which ſome authors have called certain luminous ſpaces of the heavens, ſituated near the ſouth pole, and not to be ſeen in this part of the globe. The ſailors, who firſt diſcovered them, called them clouds, and the name was a long time continued, but theſe very people ſaid they always retained theſe places, and were of the ſame uſe for obſervation in the ſtars about the north pole. There are ſeveral of them ſmaller and fainter about, but the two principal are one larger, and the other ſmaller, both under the pole. The one is ſituated between the conſtellations Hydrus and Dorado, and is the larger. The other is between the Toucan and the Hydrus. They appear of a whiter hue than the reſt of the heavens, and are permanent. And when they are examined by a teleſcope, are found to contain a great many ſmall ſtars, and among them certain ſpots, which, to the teleſcope, appear very much what the clouds, as they have been called, do of themſelves to the naked eye; and as the reſt of the ſpace owes its brightneſs to the blended light of thoſe ſeveral ſtars which the teleſcope diſcovers, theſe, doubtleſs, owe their appearance to other leſſer ſtars, which are, in themſelves, inviſible for want of better inſtruments, but whoſe mingled light comes down to us under this aſſiſtance. From this it is plain, that theſe clouds, as they are called, are truly of the nature of our Milky Way in the heavens, viſible here, only of leſs extent.

There have not been wanting, however, authors who have aſſerted the light of theſe ſpaces to be independent of ſtars: they have ſuppoſed them to be, in their own nature, luminous tracts of the heavens, enjoying an everlaſting day-light, and have accounted, on the ſame plan, for that appearance of light which is mentioned in the Moſaic account of the creation before the appearance of the ſun. They have at firſt argued upon the aſſertion of no ſtars being ſeen in them; and afterwards have ſuppoſed that the ſtars, which teleſcopes have diſcovered in them, and unto which they doubtleſs owe their light, had no concern in the appearance, but that being placed at a vaſt diſtance behind, they were ſeen through theſe tranſparent and enlightened ſpaces. The ſame ſpecies of reaſoning has carried others to the ſuppoſing the nebulous or cloudy ſtars, as that in Orion and the reſt, to be of the ſame kind, only tracts in the firmament enjoying an everlaſting day independently of any ſtars at all, but fixed ſtars are alſo ſeen in theſe. In that of Orion, in particular, a teleſcope of moderate power ſhews two, and, inſtruments of more efficacy, more than twenty. Theſe are indeed of the ſame nature with the magellanic clouds, but they owe their light alſo to ſtars. In fine, the magellanic clouds, or luminous ſpaces, or nebulous ſtars, or by whatſoever other name we call thoſe parts of the firmament in which we diſtinguiſh only a confuſed brightneſs, do, without queſtion, owe it to the mixed light of a great number of ſmall ſtars, and they are all of the nature of the Milky Way.

COCHAB. A name by which ſome, who love hard words, call the planet Mercury. It is one of the Hebrew names of that planet, and ſignifies a bright ſtar.

COCHAN. A name by which thoſe, who are fond of uncommon terms, call the planet Mercury. It is one of the Hebrew names of that planet, and it ſignifies a bright ſtar.

COCK, *Gallus.* A name by which ſome have called a new conſtellation, formed out of ſome ſtars properly belonging to the conſtellation Argo, and preſerved to it by the generality of writers; ſo that this is little regarded.

COLUBER TORTUOSUS, *the crooked Serpent.* A name by which many of the old writers have called the conſtellation Draco in the northern hemiſphere. The name ſeems to have been firſt given to it in the book of Job, where the author, expreſſing the power of God in the works of the creation, ſays, his ſpirit beautified the heavens, and his hands had formed the Crooked Serpent. Some have imagined, that no more was meant by this, but that God was the creator of all things, the greateſt as well as the leaſt, and that the ſame hand, which had formed the vaſt expanſe of the heavens, had alſo created the meaneſt reptile on the earth. But the context ſhews abundantly that he meant nothing on the earth; and the uſe that was made very early, both by huſbandmen and ſailors, of the conſtellation Draco, leaves it undoubted, that this was the peculiar conſtellation the author meant.

COLURE *of the Solſtices.* That meridian, or circle of declination, which paſſes through the poles of the equator, and thoſe of the ecliptic. The Colure of the equinoxes is that circle which paſſes through the poles of the ecliptic, and the interſections of the ecliptic with the equator. Theſe two Colures cut one another at right angles, and divide the ecliptic and the equator into two equal parts.

COMMUNIS STELLA. A name by which we find ſome authors calling the planet Mercury. To underſtand what they mean by this term, we muſt enter into their eſtabliſhed opinion. Aſtronomy was at firſt joined with judicial aſtrology. Thoſe, who firſt remarked the courſe of the planets, expected good and ill from their aſpects, and were perſuaded that, in themſelves, they had naturally good and bad influences. Thus they called Jupiter a ſtar of good fortune, and Saturn and Mars ſtars of ill fortune. Mercury they ſuppoſed to deſerve neither one nor the other character, but to influence according to the aſpect in which it ſtood.

CONCEPTACULUM. A name by which certain, who love uncommon terms, have called the conſtellation Ara, the Altar. It is one of the old names for that conſtellation; we meet with it in the Latin poets, but it is quite out of uſe among the late writers.

CONJUNCTION, in the writings of the aſtrologers, ſignifies particularly the coming of certain planets into the ſame part of the heavens with ſome one of the conſtellations to which they are ſuppoſed to have ſome affinity. This is the aſpect under which they form the moſt bold of their preſages.

CONSEQUENT QUANTITY. That of two quantities, which have a ratio to one another, which is named laſt. *See* RATIO.

CONSPECTUS. A term by which ſome of the Latin writers have expreſſed what the aſtrologers meant by their word aſpect, a mutual radiation of certain planets and certain ſtars on one another at certain diſtances, the trine, quadrate, or the like, from whence they preſaged events, and pretended to be let into the

ſecrets of futurity. We find the word in Cenſorinus and others.

CONTEMPORARY LIGHT. This term is uſed to expreſs that quantity of light which falls at any one time upon an object. This is uſed by way of diſtinction from the term ſucceſſive light, which denotes that which is thrown upon it at ſucceeding intervals. *See the article* LIGHT.

COLOURS. The origin of colours is in the different refrangibility of the ſeveral rays of light. Newton ſuppoſed the whole body of light to conſiſt of certain extremely minute particles of matter; and the ſame Newton, ſeparating that light by after-experiments, diſcovered, that thoſe particles were not of the ſame ſize in all the parts, or, in other words, in all the rays of light; he found them larger in ſome, and ſmaller in others, by the different degrees of refrangibility and reflexibility: and to this he refers the origin of colours. Thoſe rays, which conſiſt of the largeſt particles being red; thoſe, which conſiſt of the ſmalleſt of all, violet coloured; and thoſe of intermediate degrees, conſtituting the intermediate colours of green, blue, yellow, and orange. Theſe ſix colours are called primary colours, and the rays of light, which produce them, are called ſimilar, or homogeneal rays. All other colours ariſe out of different mixtures of theſe primary colours, or different combinations of the homogeneal rays. Light is a mixture of all the ſeveral rays of light; and, in the ſame manner, whiteneſs is a mixture of all the kinds of colours. *See this farther explained under the article* REFRACTION.

‡ COLUMBA NOACHI, *Noah's Dove, or, as ſome expreſs it, the Pigeon.* One of the conſtellations of the ſouthern hemiſphere; it is not of the number of the forty-eight old ones, mentioned by the antient aſtronomers, but has been found ſince their time, and the name of it is formed only among the lateſt.

It is but a ſmall conſtellation; but, for its extent, it takes up a proper number of ſtars. It is repreſented by a tolerably good drawing, and is the figure of the Dove, which Noah ſent out of the ark, returning with an olive-branch in the mouth, an emblem of the decreaſe of the waters. The conſtellations, between and among which this little one of the Dove is placed, are the Dog, the Hare, a part of the Eridanus, Dorado, and the Ship. The olive-branch in the mouth, and a part of one of the wings, come very near the hinder legs of the Dog. The Hare is at a ſmall diſtance behind the Dove's tail, which points toward the place of its fore feet. One bend of the Eridanus comes toward the wing, oppoſite to that which is near the hinder legs. The Dorado is oppoſite to the top of that wing, but at a diſtance; and the ſtern of the ſhip is very near the head of the Dove, ſo that it might ſeem the ark to which the bird is flying.

The ſtars in the conſtellation Columba are ten, and they are very happily diſpoſed for marking of the figure. There is one in the hinder part of the bird's head, and there are five on its body, two in one line, and three in another, the three are ſmaller ſtars than the two, theſe very well define the bigneſs and figure of the body: there are three almoſt in a line in the olive-branch, and one in the under wing.

The new conſtellations, like the old, were ſome of them intended merely as forms that would beſt compriſe the ſtars that were to be referred to, and ſome in commemoration of great events. This Dove is in remembrance of the

deluge

deluge in the days of Noah: the Royal Oak, in commemoration of the preservation of our king Charles, and so of some of the others: these a thousand years hence may be as inexplicable as any of the old ones; and we are not to wonder, that we do not perfectly understand those: we are to remember, histories do not last for ever.

COLURE *of the Moon.* Some of the astronomical writers have called by this name a great circle of the globe of the moon, parallel to the great circle which passes through the poles of her orbit, and through those of the ecliptic. They have called this the colure of the moon, from the same reason that others have given the name of the colure of the solstices to that great circle which passes through the poles of the equinoctial and ecliptic, at the distance of ninety degrees from the intersection of those two circles. The poles of the moon are at all times in this circle; and from the motion of this circle, and that of the poles of the moon from east to west, the appearance of the spots of the moon being fixed in the same places, while the globe of that planet turns like the other heavenly bodies round its axis, is explained. This will be demonstrated at large in its place under the article Moon.

† COMA BERENICES, *Berenice's Hair.* One of the constellations of the northern hemisphere. It is of a middle date as to its origin, being much older than the Lynx and Unicorn, and the rest of those which Hevelius, and others, near our own time, have added, and yet much later than the forty-eight old ones, of which we read in the earliest astronomers. The constellations, which the early Greeks were acquainted withal, were, probably, designed by the Egyptians, and by them taught to that people, who afterwards diffused the knowledge of them throughout the world; but these did not comprehend all the stars of which men frequently found occasion to speak. There were left spaces between them in the heavens, and the stars in those spaces were called Stellæ Amorphotæ, or Informes, or unformed stars, and accounted to the next constellation. It was a deficiency in the early astronomy, not to have provided properly for these; and it was an aukward and round-about way of speaking that they were forced to have recourse to in calling these the unformed stars of this or that constellation, from which, perhaps, some of them were very distant, and many of them equally near to some other.

Astronomers, of succeeding times, perceived this, and, by degrees, they have, though not yet sufficiently, improved the system: they have collected the most considerable of these stars into other constellations, and they have filled up the largest spaces. Much of the praise of this is owing to Hevelius, but the thing was begun very long before his time. This constellation of Coma Berenices is an instance of it. It was added to the sphere so long since as in the days of Conon, who placed the unformed stars behind the Lion in the figure of a lock of hair, to commemorate a certain lock which Berenice, the queen of Ptolemy Euergetes, had dedicated in a temple of Venus, on account of one of her husband's victories, and which had been, by some accident, lost out of the place. Conon perpetuated the act of devotion more than could have been done by all the reliques in the world, and, at the same time, did an acceptable service to all succeeding astronomers.

The Coma Berenices is a constellation of some bigness, and contains a quantity of stars very well proportioned to the space which it occupies in the heavens. It is represented in the schemes of the heavens in form of a cluster of

hair

hair tied up at one end, and flowing loofe at the other. It is fituated between the Lion, the Little Lion, the Great Bear, the Greyhounds, Bootes, and Virgo. It is behind the tail of the Lion, and at fome diftance from the hinder leg of the Bear. The belly of the lower of the two Greyhounds comes juft over it. The difhevelled, or loofe part of it, reaches nearly to the leg of Bootes, and the whole clufter, or lock, runs parallel, or nearly fo, with one of the wings of Virgo.

Tycho Brahe mentions only fourteen ftars in the Coma Berenices. Hevelius raifes the number to twenty-one; and Flamftead makes it forty-three. They are none of them of the largeft magnitudes, but a great many are confiderable enough to be very confpicuous, and they are very equally difperfed over the feveral parts of the conftellation. There are five of confiderable fize in the centre, or nearly in the centre, of the part that is tied up; and there are fome others about thefe, and fcattered fingly at diftances. There are two in the band, or tying, and the reft fpread very well at equal diftances over the whole difhevelled, or loofe part. There are feveral ftars about it, which it would have been as well to have comprifed within the out-lines of the figure, and which might very well have been comprifed fo; but, as it is, the conftellation is of very confiderable ufe, and is eafily diftinguifhed by the eye.

COMETS. A kind of ftars, appearing at unexpected times in the heavens, and of fingular and various figures, which, while their motions were not underftood, were imagined to be planets and prodigies, hung out by the immediate hand of God in the heavens, and intended to alarm the world. There have appeared many of thefe, at different times, of a variety of figures, and extremely different in apparent magnitude; but we at prefent have obtained fome knowledge of their laws and revolutions, and, as it is in all other cafes, being underftood, they are no longer terrible. Before we enter into the explanation of their feveral motions and appearances, it will be proper to diftinguifh, among the accounts that are left us of them, what have, and what have not been comets, at leaft to obferve, that all which have been called by that name have not a right to it; and to add, that fome appearances in the heavens, which have not been called by that name, have a right to it.

We read of what are called new ftars in the earlier as well as later works in aftronomy, and there are not wanting authors who fuppofe all thefe to have been comets; but this is an error of the groffeft kind. The moft confiderable of all thefe, the new ftar in Caffiopeia, which was feen in 1572 for fixteen months together, was by fome fuppofed a comet, but that opinion was abfurd in the higheft degree; it had no tail, nor any of that hairy appearance which fome comets have which want the tail, and to this its light was of that brilliant kind which diftinguifhes the fixed ftars. But this is little proof. It was far out of the limits of the folar fyftem; its place was in the region of the fixed ftars, and it preferved exactly the fame place there, ftanding in the fame fituation with the feveral ftars about it, from the firft to the laft moment of its appearance.

We read of many other appearances in the heavens under the name of new ftars, but we are not fo well able to judge what they were, from the want of accuracy in the obfervers. Pliny tells us of one, feen, as he fays, by Hipparchus, one hundred and twenty-five years before Chrift; another was feen in the time of Hadrian, one hundred and thirty years after Chrift; a third, its place afcertained near the Eagle, in the year three hundred eighty-nine, feen

seen by Cuspicianus; a fourth, seen by Haly and Albunazar, in the ninth century, in the fifteenth degree of Scorpion; another in nine hundred and forty-five, between Cepheus and Cassiopeia; and another in one thousand two hundred and sixty-four near Cassiopeia. The accounts of these are all very imperfect, possibly some of them might be comets, but certainly not all. The star in Cassiopeia (and probably the greater part of the others, were like it) was undoubtedly a fixed star, and is undoubtedly still in its place, though unseen. We know of many others which appear and disappear at times, and it is owing either to a revolution upon their axis, which discovers, at some times, an enlightened or fiery, and others, an obscure part of their surface; or to their occasionally throwing up, from the fiery mass of which they are composed, opake matters, such as form the spots in the sun, but in such quantity that they obscure it with the whole surface, at least so much of it as not to leave enough vacant or clear to transmit the light to us at this vast distance.

Howsoever that be, we, of a certainty, know, that the new star in Cassiopeia, and many others of that name, were out of our system, and among the fixed stars and stationary like them. This sufficiently distinguishes them from the comets truly such, for these are, although a very remote part, yet a part of our system, and belong to this part of the universe of which the sun is the centre.

Objects, so very visible, and so very singular, cannot escape the notice of those who addicted themselves to observations of the heavens. Accordingly we find them named from all antiquity, though never, till very lately, at all ununderstood. The Chaldæans, from whom we trace the knowledge of the stars, as they were favoured in point of climate, and naturally, and, from immemorial time, addicted to observations of the heavens, could not but see them at times. They had a custom of entering down, in the public registers, the extraordinary phænomena of the airy region, and these certainly had their place there. They were so well acquainted with the constellations, and places of the fixed stars, that they could not but perceive the comets were not of their number. They watched several from their first appearance till they became invisible, and they could not but perceive that they changed their place in the heavens in the manner of the planets. Thus much we may, with reason, suppose the Chaldæans knew concerning comets. We are told indeed, by those who have written concerning the antient astronomy, that they foretold the appearance of them; but this has not the least foundation. They knew that the comets were not fixed stars, but had some revolution; and that is all that has been known of them till of very late time.

Comets are indeed no other than planets of a peculiar kind, and they are planets belonging to our own solar system. They turn about the sun as Jupiter and Saturn do, but they are at a vastly greater distance from him. Although we see so little of them, or have opportunities of viewing them so rarely, there are more in number of them, than what we usually call the planets, and their bigness and motions shew, that they are truly of the nature of those planets. We also discover, by the same means, that they perform their revolutions about the sun in ellipses, so extremely long, that the part of them which comes within our view has the figure of a parabola. This must have appeared a strange doctrine at the time when the earth and the several planets were supposed to run round the sun in circles, but it has been evidently proved by Kepler, and acknowledged and supported by all the astronomers who have succeeded him, that

1757
25
782
25
807
25
832
25
857

they do in reality all of them describe, not circles, but ellipses round the sun; the orbits therefore of the comets are not singular in figure, but are only a figure of the same nature, more extended in length.

We farther distinguish that the comets have an atmosphere about them, nay, and that it is immensely great; we can discover that the moon has no atmosphere, and we can perceive that the planets have. In regard to Saturn we absolutely see clouds suspended in it: but this of the comets is of all the most considerable; it is to this that they owe that strange appendage of a tail, which is here annexed to them, especially after the time of their perihelium.

1789
129
918
129
047

The comets must needs pass through a strange state of cold and darkness in that part of their orbit, which they run through in their aphelion, and from this they must enter into an excessive state of light and heat in their perihelium: this is owing to the extreme length of their ellipsis, and, in consequence of this, they must be, in their present state, globes utterly uninhabitable by any species of things of which it is possible for us to form the least imagination. Although unfit for any use in themselves, they may however be of infinite importance with respect to the other worlds in our system, being capable, in the hands of the Almighty, to produce strange changes and revolutions, if, in any part of their orbits, they pass near them. When they shall fall in the way of any of our planets, (the earth not excepted) in their descent toward the sun, they must, if they appreach near enough to them, be the occasion of deluges; and, if they come too close to them in their ascent again from the sun, they must occasion universal conflagrations.

1681
575
256

The comets themselves can only be therefore in a state of absolute chaos in their present condition, but they may also become planets in our sense of the word, or may be capable to receive and to sustain inhabitants like the others, if, at any time, their course should be changed, and they should be made to form circles, or ellipses, of less length about the sun. As it is, we are not to suppose that every time a comet is seen, it is a new one that appears; the same has come in sight at different times; and from this we are able to determine their periods, and events calculate their future appearances. The principles of this are plain and indisputable.

It is evident, from the comparison of a multitude of observations, that the comets, as they were called, of the years 1531, 1607, and 1682, were the same, and consequently, this having appeared at three times, of which the distances are equal, we know those distances must mark its period, and consequently that the comet, which last appeared in 1682, performs its revolution round the sun in about twenty-five years; so that if the calculation have the truth, which there is at present all the reason in the world to believe it has, we shall again see that comet in the heavens in about four years, or in the year 1757.

The comet, which was observed in 1661, seemed, by all that was observed concerning it, compared with what we know of that comet which appeared in 1532, to be the same. If this be true, the period of that comet is one hundred and twenty-nine years, and it will appear again in the heavens in the year 1789.

The most remarkable of all the comets, of which we have accounts, was that which appeared forty-four years before the birth of Christ, in the same year in which Julius Cæsar was murdered. It is palpable, from the whole course of observations, that this comet has appeared since, once in the year 531, a second time in the year 1106, and a third in the year

1681.

1681. It has made three revolutions therefore round the ſun, in the times of which we have account, and they have been at regular periods that it was ſeen. The period of this comet's revolution is therefore about five hundred and ſeventy-five years, and it will be very long before mankind will have an opportunity of ſeeing it again. This is the comet to which Mr. Whiſton, who has explained at large how the earth may be drowned or burnt by a comet's paſſing too near it in its deſcent to, or in its aſcent from, the ſun, refers the general deluge in the days of Noah.

The orbits of theſe comets have alſo been explained, and it appears, that the firſt mentioned in its aphelion, is four times as far from the ſun as Saturn. Its greateſt diſtance appears to be to its leaſt in the proportion of ſixty to one; and its greateſt degree of heat and light, compared to its leaſt, muſt be as three thouſand ſix hundred to one. How amazing a viciſſitude! The comets may be well declared uninhabitable.

The ſecond, in its aphelion, is near ſix times as remote from the ſun as Saturn is in his aphelion, its greateſt diſtance to its leaſt as one hundred to one, and its greateſt degree of heat and light, compared to its leaſt, as one thouſand to one.

The aphelion of the third muſt be fourteen times greater than that of Saturn, its greateſt diſtance from the ſun, compared to its leaſt, muſt be as twenty thouſand to one; and its greateſt degree of heat and light, proportioned to its leaſt, as four hundred millions to one. As we have been amazed at the viciſſitudes of the firſt comet, with what thoughts of aſtoniſhment muſt we ſurvey thoſe of the laſt?

Notwithſtanding this vaſt diſtance of the comets from the ſun, particularly that of the laſt in the time of its aphelion, yet, on the moſt moderate computation, the diſtance of the neareſt of the fixed ſtars is ſo immenſely greater, that, in the moſt remote part of their orbits, they cannot approach ſo far toward any of thoſe as to fall in the way of their influence, or have their courſe in the leaſt diſtubed by them, but may perform all parts of it with an uniform regularity: therefore, after a proper number of obſervations they are as liable to have their revolutions calculated, as the neareſt of the planets. Thirty or forty years more will ſtrengthen or invalidate this ſyſtem.

What we learn farther by theſe obſervations is, that thoſe comets, which have given us opportunities for examination, are very large bodies, and are ſurrounded with an atmoſphere of great extent: this atmoſphere, like that of the earth, is thickeſt, or moſt denſe, toward the centre, or near the body of the comet, and proportionably more rare at a diſtance, till it is moſt ſo at the ſuperficies; and the diſorder and confuſion of its parts very well repreſent the ſtate of a planet in chaos. When they are near the ſun, it appears that their atmoſphere turns round of itſelf, in the manner of a globe that turns upon its centre, and this toward the ſide oppoſite to the ſun; as if the vapours, of which it is compoſed, were puſhed forward by the ſun's rays. We obſerve, in general, that their tails are the longer in proportion as the body of the comet is nearer to the ſun, and conſequently more influenced by the heat of that luminary.

There have been many obſervations to prove that theſe three comets, which have been particulariſed above, are, in reality, as repreſented, the ſame individuals, each having appeared at its period. It has been found, that their degree of motion was, in all theſe ſeveral appearances, the ſame, and their colour alſo the ſame. We find, by the return of theſe, that their orbits are of different extent, and it is owing to this that they appear for a different ſpace of time in the heavens within the reach of

of our eyes, or of our telescopes. In proportion to the greatness of its orbit, the comet appears to run through a larger space of the heavens under our eye; for the more extensive is the ellipsis, the less is the curve of the line, but there has been very seldom seen a comet that has gone through the half of the heavens; for in the place where the ellipsis is most bent, it is in that place that the comet begins to re-ascend, and to render its apparent motion slower, although it do, in reality, move at all times with an equal degree of velocity.

The French astronomers observed a little comet in 1723 in Capricorn, and many more were inclined to believe it the same with another little comet which had been seen in the same part of the heavens in 1707, but the best and most accurate observations of the last seemed to determine otherwise. Comets have been observed to preserve their course in very different ranks, for some of them have not followed the path of the zodiac nor parallels, but some have travelled from north to south, others from south to north, and others in other directions. It is this irregularity that has given origin to the variety of conjectures as to the real nature of the comets. We have many authors who speak of them as bodies perfectly irregular in their motions, and even so great a name as Kepler's stands to the opinion that they are no other than fires in the region of unbounded space, which become illuminated at once, kindling, as it were, in a moment, and dissipating themselves afterwards by little and little. There have not been wanting men of some knowledge who have adhered to this opinion. De La Hire, an astronomer of reputation in France, has left it upon record in the memoirs of the Paris academy, that he adheres to this system. Seneca observes, among the several things that may be expected from the progress of science, that, probably, the time will come when some astronomer shall explain the motions of the comets. However distant we should be from it, on such foundations as this sentiment of Kepler, the time seems to have been approaching with our Newton; and perhaps, in another century, the prediction of the philosopher will be wholly accomplished.

The opinion of Protagoras, received by many of the old philosophers, was, that every comet consisted of a great number of small stars, that these were of the nature of planets, and performed a revolution in the heavens; that when they were alone they were invisible, being too little for the discernment of the human eye, but there were times when they got together, and that in this cluster they became visible, continuing so as long as they continued together, and after that disappearing by degrees, as the several little stars separated again from one another. Others, adhering to the system of Kepler, have supposed the comets to be no other than exhalations from the sun itself, and to have become inflamed as they were in his atmosphere, in the same manner as the vapours of our earth become sometimes illuminated in its atmosphere. But these are too idle to be received by any who have the least tincture of true knowledge. The system of Descartes had much more appearance in its favour; he asserted, that the comets were truly stars or planets, and that they moved in vast circles out of our system, and wholly uninfluenced by our sun, and that they were only visible to us when in that part of their circle which approached toward our system. Cassini adopted this system, and wrote largely in its favour; but appearances only were to be alledged in its behalf. It is beyond a doubt that the comets are a part of our system, revolving round our sun, and without this first true principle, it is impossible we should make any thing out in their history.

While

While we have been able to calculate the periods of only three or four of the comets, we are ſenſible, that there are a much larger number of them in the heavens. Thoſe which have been obſerved at times, by no means correſpondent with any others, and of appearance ſo unlike all others, that they ſeem evidently to many different individuals, though of the ſame general nature, encreaſe the number to at leaſt twenty; and we are to obſerve, at the ſame time, that ſome have been ſo ſmall as to be ſeen only by the beſt teleſcopes. Theſe can have been diſcovered no way but by accident; the teleſcope of ſome aſtronomer having been for ſome other reaſons, and with no intent of looking after comets, directed toward the place where they were. Beſide, the few that have been thus ſeen by accident, there may be many of the ſame kind too remote alſo to be viſible to the naked eye; and even among thoſe which do come near enough to the earth to offer themſelves to the unaſſiſted ſight in ſome part of their orbit, may, at the ſame time, chance to be ſo near the ſun, as to be immerſed in his rays, and therefore inviſible; for there is no ſtar of any kind, that may not be hid from us in that manner. We are to add, that the orbits of the ſeveral comets are not all of the ſame place, but in places different from one another, and, as a conſequence of this, we muſt be ſenſible, that their heliocentric circles will be different alſo. If an obſerver could be placed in the centre of the ſun, every comet, ſuppoſing that it could be ſeen throughout an entire revolution, would appear to deſcribe a great circle upon the ſphere of the heaven; for although the orbit of a comet be in truth a long ellipſis, the plane of that orbit, extended to theheavens, would make a great circle there, and the eye in the centre of the ſun, would be at the centre of that circle. All that would appear different from this would be, that as the comet does in reality move round the ſun in an ellipſis, it would ſeem to grow larger, as it came nearer to the ſun, and ſmaller, as it was farther off. This would be all the difference.

Upon the whole it appears, from manifeſt evidence, that the comets are indeed of the nature of planets, only that their orbits differ: that thoſe which fall within the reach of our eyes are all truly parts of our own ſyſtem, and have, as this earth and the reſt of the planets have, the ſun for the centre of their revolution. The orbit of every comet is then an ellipſis of a very excentric kind, having the ſun in one of its focus's. Their motion round the ſun is conſequently not equable, but a line drawn from the ſun to the comet, paſſes over equal areas upon the plane of its ellipſis in unequal times. Therefore it is evident, that comets move much ſwifter when they are neareſt to the ſun, than they do at thoſe times when they are fartheſt off, and that they have a mean motion at the parts of their orbits, which are at a mean diſtance from theſe extremes. And it is evident, that the more excentric the orbit of a comet is, the greater difference there will be between the arcs it moves through in equal times. It requires a conſideration of this difference, to underſtand at all the period of a comet; for if we knew the exact extent of its ellipſis, and counted by the motion which it had when near the ſun, we ſhould be very far from having the account of its true period, for the ſame comet may move extremely faſt while it is near the ſun, and extremely ſlow when at a diſtance from it. It is only in a very ſmall part of their courſe, that the comets are viſible to us; it is neceſſary to our ſeeing them, that they ſhould be as near to the ſun as the orbit of Jupiter. Sir Iſaac Newton has laid it down as a certainty, that when they are farther from the ſun, they are inviſible to the inhabitants of this earth. It is not a wonder, therefore, that notwithſtanding they are ſo

 many,

many, we so seldom see any of them, since they are, for the greatest part of their periods, performing portions of their revolutions, which are in a part of the heavens remote from us, and which they perform very slowly.

The sun has been, by some, imagined to be a congeries of a vast number of comets; they have allotted ten thousand to make up the superficial part of that luminary; and others, who have paid no regard to such opinions, have yet supposed, that, if not originally formed of them, the sun was occasionally recruited by them; and this they have supposed to be one of their greatest uses in the system of nature. Many other conjectures have been made as to the intent with which these wandering stars were formed, and the purpose to which they serve in the œconomy of the universe. That they were a kind of chaos of planets, ready to be called into being in form of planets, or worlds like this, in which we live, at the command of heaven, and to have their long ellipsis changed into such an one as marks the orbits of the other planets; and that they were instruments in the hands of heaven against the other planets ready to drown, or to burn them, by falling upon them in their descent to, or in their ascent from, the sun; has been observed already. But there are purposes, which true philosophy will find out, that they may serve independently of those immediate shocks, or of those changes. The greatest of all authors, on this subject, Sir Isaac Newton, is of opinion, that, even in their present ordinary course, they serve to keep together and preserve, in its due form and condition, the whole system of that universe, of which they are ordinarily conceived so small a part; and which they are supposed to threaten with continual mischief in some part or other. It is his opinion, that they may supply the sun with fire, and the planets with water. This will be easily explained.

It appears reasonable, that the sun must waste in bulk, and, if it be so, to keep nature in her due course, and support this system to which we belong, it must have some means of recruit. It is true, that the particles of light we know are inconceivably minute, but still they are something, and they are continually streaming from the body of the sun. Small as they are, therefore, in such a course of time, and in such quantities as they are sent from his body, they must, by degrees, waste or impair his bulk; and, if this diminution is certain, a support is necessary. Now comets, which, in their revolution round the sun, come so near to it as to be within its atmosphere in their passage, may have their motions retarded in that part of their course, by the density of the atmosphere: this indeed must be a consequence, and, approaching nearer and nearer to the sun's body at every revolution, they may at length fall into it. Such a supply would be very small, and could be supposed to happen but rarely; but still it is a supply, and the waste being also very small, it may be calculated by that hand that governs all things to recruit it.

With regard to the other use of comets, it is very clear that water is raised from them, and returns not to them again: this is as evident as that the water of the planetary worlds necessarily decreases. We are assured that comets abound with watery matter, and we are as certain, that, in their approach toward the sun, that water is, in part, raised in vapour. It is this vapour which forms what is called the tail of the comet. We see these tails, that is, we see immense quantities of watery vapours attending comets in that part of their course which is nearest to the sun, and we see those tails, or that vast collection of watery vapours sent off with them into the more remote regions, where they will be lost by little and little, and the comet will become bare, continuing so till its approach

toward

toward the ſun again produces this appendage. The vapours thus brought with the comet from the part of its courſe neareſt to the ſun, and loſt in the remoter part of its orbit, are, in this dilated and rarified ſtate, ſpread throughout the airy region, but they will not continue ſuſpended in it, they are too heavy for that, and they will, by means of their gravity, be, by degrees, attracted down toward one or other of the planets, and will make part of their atmoſphere; intermingling themſelves with the reſt. We are not to ſuppoſe that the atmoſpheres of thoſe planets will, by this means, become overloaded with water for the ſupplies of the planet. On the contrary, it appears that there would be a defect without this, and that the comets are neceſſary for the keeping up a due proportion of water in the planets. We may well know, by what paſſes upon our own earth, for it is from what we ſee there we are to judge, that the water of the globe is in a ſtate of decreaſe, a great quantity of it being, from time to time, converted into earth. Vegetations, which are the produce in great part of water, convert it into ſolid forms, from which it does not all of it return in water, and the effect of putrefactions we know to be the ſame. The water of the globe decreaſes: a due proportion of that fluid is neceſſary for the preſervation and ſupport of its own frame, and of all that grow upon it, or inhabit it. What is loſt therefore muſt be ſome way ſupplied, and we ſee that it may be done this way, and only this, ſo far as appears to us. The condenſed vapours of the comets may, when diſſipated in the air in the vaſt regions of ſpace, and taken up by the ſeveral planets, by being attracted into their atmoſphere, add to their fluid in a quantity equal or proportioned to that which is expended by the ſeveral methods mentioned already.

All vegetables, we are ſenſible, grow and increaſe by means of fluids. From ſmall and inconſiderable beginnings they advance in this manner, and, by this ſupply, to trees: and we are equally ſenſible, that, after their putrefaction, they do, in a great part, become earth: for we ſee an earthy ſediment precipitated from all putrefying liquors. We ſee thus a quantity of fluid continually loſt. This is the courſe of nature, and it is very eaſy to ſee, that, in conſequence of this courſe, the earth of the globe muſt be continually increaſing at the expence of its fluids, and that, by degrees, there would not be enough of the laſt to perform the natural operations, if a ſupply were not occaſionally to be brought from elſewhere. The comets afford this ſupply. That they do ſo is evident, becauſe the vapours, which form their tails, being ſeparated from their bodies, and diffuſed in the expanſe of the air, muſt go ſomewhere, and it does appear, not only that it will be added to the atmoſphere of the planets, but that it is neceſſary to their preſervation that it ſhould be ſo added. Theſe are two uſes which the diſcernment of that great author has diſcovered, may be made of the comets in the ſyſtem of nature; and he adds a conjecture of a third yet greater. He delivers it as his opinion, that the ſpirit, which conſtitutes the fineſt and ſubtileſt part of our air, and which is of abſolute neceſſity for the life and being of all things, comes principally from the comets. This ſpirit has been ſuppoſed a pure elementary fire: but of this, as neither the ſubſtance itſelf, nor its immediate effects, are properly cognizable by our ſenſes, there is no ſpeaking with that preciſion with which we may concerning the others. All is conjecture, but it depends upon conjecture well ſupported.

Having thus conſidered the nature of the comets, and the theory of their motions, it may be time to examine their ſeveral forms and appearances, as well to the naked eye as to the teleſcope. This might naturally have been

been expected as the first consideration, but it is after these observations only that the whole will be properly conceived, and the phænomena understood.

It has been observed, that the tail, which is the great characteristic of the comet, is not at all times an appendage to it. It is a congeries of vapours formed by the effect of the sun's heat upon the surface of the comet, and, by degrees, separating themselves from it, and descending into the atmosphere of the planets. A comet, in its orbit, is a great while at a vast distance from the sun and us, and in all that time it is bare, or naked; it is only a small part of its course which lies near the sun, and it is only in that part that it has this tail, or appendage of vapours in whatever form; but this being the only part of its course in which it is visible to us, we always see it with this appendage of vapours in some form or other. In all the remote part of the course it is, as observed, naked: as it descends toward the sun some little short tail is gradually and slowly produced from the head, and this afterwards, in the perihelion of the comet, descending down into the sun's atmosphere, will be vastly increased. And it is thus we see them of different lengths and forms.

A comet is then a firm, solid, and durable body, which, at the times when we have opportunities of observing it, is always attended with a tail in some form or other, and this tail, in whatsoever form it appears to us, is a very fine and thin vapour emitted by the body, or, as some call it, the head of the comet, in consequence of its being heated by the sun.

It is to the different form in which this tail, or emanation of vapours is disposed, that we owe all the different appearances of comets, according to which they have been expressed by several names. The three principal of these are the bearded, the tailed, and the hairy comet, the Barbatus, Caudatus, and Crinitus; the same tail, or quantity of vapours, according to the different disposition and place of the comet, with respect to the sun and the earth, appearing as a beard, a tail, or a bush of hair. When the comet is to the east of the sun, and in its progression moves from that luminary, the light is before it, and the vapours enlightened there, form a kind of beard. This is the situation in which it forms what is called the bearded comet. When, on the other hand, it is westward of the sun, the comet is said to be tailed, Caudatus, the stream of illuminated vapours following it in the manner of a tail; and, finally, when the comet and the sun are in opposition, and the earth is between them, the appearance is quite of another kind. The train of light is, in this case, hid behind the body of the comet, only that being larger than can be wholly obscured by it, a part of the tail is seen disposed all round the body of the star, in form of a bush of hair. This is the state in which the comet is called hairy. From this consideration it will appear, that the names given to these several appearances, and with which the world have been so terrified, are, in effect, the produce of different accidents attending the same comet, and the position of the eye that views it; and that instead of their being three distinct species of bodies, the same comet may, in the different parts of its course, be at one time a bearded, at another a tailed, and at a third an hairy one.

The tail of the comet is not only its characteristic of distinction from all other stars, but it serves to explain its nature. When Aristotle had overthrown the chimerical opinion mentioned before of the comets being only congeries of stars, too little to be visible singly, he established in its place that system, according to which they were to be understood only as a kind of meteors, lighted up at once

once in the regions of the air, and by degrees burning themſelves out again. But this will no more bear the teſt of enquiry than the other; for, if this were the caſe, there could be no train or tail, that being an effect of the ſun's influence, of which comets, in this caſe, would be independent. Ariſtotle placed them indeed beneath the courſe of the moon; but others, who have, in ſome degree, adhered to the ſame opinion, have ſuppoſed them ſituated a great deal higher, placing them very near the ſun; and ſome of them, ſuppoſing them even formed out of exhalations from the body of that luminary, condenſed after they have left his ſurface: but not only the appearance of a tail, but the duration of the comet's appearance in the extreme heat of the ſun, to which ſome of them are in a part of their courſe liable, and which muſt diſſipate the moſt condenſed vapour, ſhew, that they are indeed fixed and ſolid bodies, and that they have their revolutions as the planets have them.

It is evident from the conſideration of comets as bodies, ſuch as they are here laid down to be, that the atmoſphere of any of them muſt be ſufficient to form its tail. The vapours will be produced in ſufficient quantity to form it in all the extent in which we ſee it, and the appearances we ſee in it perfectly anſwer to this origin. This will be ſeen by conſidering theſe ſeveral appearances. We find their tails are always the largeſt and brighteſt immediately after their paſſage thro' the region of the ſun. They are brighter, and they are more determinate, or better defined in their convex, than in their concave part; and they are always broader in the farther end, than near the body of the comet. It is plain by this, that they are formed of vapours, and illuminated by the ſun; and thence it is evident, theſe muſt be the appearances. This ſtream of illuminated vapour is ſo thin and rare, that the ſmalleſt ſtars which are, on any other occaſion, viſible to the naked eye, are ſeen through it. While it is itſelf ſo conſpicuous, it does not at all obſtruct the view with reſpect to any thing behind it.

The tail of a comet, for it may be warrantable to call it by that name, in whatſoever form it happens to appear, as it is abſolutely the ſame in all, is at all times of the ſame uniform colour, which is that of vapour, enlightened by the ſun. Whether it be diſpoſed all round the comet in form of hair, or advance before it as a beard, or be drawn behind it in the more regular appearance of a tail, it is ſtill of the ſame bright white colour. But it is otherwiſe with the body of the comet, that is opake, and as it is illuminated and ignited in a different degree, or as it is compoſed of materials in themſelves different (for we are not to ſuppoſe all comets exactly alike) in this reſpect it appears of a different hue. It is by this, among other things, that the ſeveral comets, which have appeared at different times, have been diſcovered to be, in ſome caſes, the ſame with, and, in others, different from, one another.

Thoſe of different periods have appeared to the naked eye, ſome of a pure and bright white, others dim and troubled, ſome reddiſh, and others abſolutely fiery. But at all times they have a peculiarity in their look, and their very light diſtinguiſhes them, both from the fixed ſtars and planets. If their tails were wanting, an accuſtomed eye would know them for comets only by their light. We diſtinguiſh the fixed ſtars from the reſt of the heavenly bodies by their twinkling, their brilliant, and lively light; this is the conſequence of their being luminous in themſelves, or having the ſource of light in their own bodies. The planets

nets are, on the other hand, diſtinguiſhed by their ſteady light: although very bright, it has a ſtillneſs and tranquility, which is the conſequence of its being reflected, not inherent in themſelves. Now the comets being in reality in a condition between theſe two ſtates, have a peculiarity of aſpect which diſtinguiſhes them from both. They are naturally opake bodies, as are the planets; but their courſe leading them in one part of it very near the ſun, they become heated in an immoderate degree, and ſhine. It is not a wonder, that they ſhould therefore appear different not only from the fixed ſtars, whoſe full luſtre is incomparably greater, but from the planets alſo, which never are ignited at all.

This peculiarity of appearance, although it be ſufficiently viſible to the naked eye to diſtinguiſh them from all other of the heavenly bodies, yet is much more particular, and characteriſes them much more ſtrongly when they are viewed with the aſſiſtance of teleſcopes. When viewed under this advantage, they are found entirely different from all the other ſtars. When we look at the fixed ſtars, even at the largeſt of them, they appear little more than lucid points, and what we ſee of their diſk is all uniform. The planets, when viewed with the ſame advantage, appear enlarged, and they are ſeen to have a placid and bright light, like that of the moon, and to be like her, obſcured with various ſpots: but when we direct the ſame inſtruments to the body of a comet, we ſee a very different appearance. In the firſt place, the diſk becomes enlarged in the manner of thoſe of the planets, although in a ſomewhat leſs proportion; in that, differing from the appearance of the fixed ſtars, and ſhewing that the comet, although beyond the orbit of the fartheſt planet, yet is not remote in any degree like the fixed ſtars, nor placed in their region.

The colour and appearance are quite different from thoſe of all other ſtars, and though not alike in all comets, nor indeed in the ſame comet at all times, yet abundantly ſufficient to diſtinguiſh the object as ſuch. Some of them appear yellowiſh, others reddiſh, and many of them duſky. All have the look of ſome ignited matter, or ſeem, as they truly are, globes of ſolid and denſe materials, not always kept hot, but accidentally ignited, and, by degrees, cooling again: they have the appearance of a glowing coal, more or leſs brightly burning, and, in itſelf, more or leſs pure. Some have appeared, throughout their whole diſk, equally, or nearly equally, enlightened, and others very glowing in the middle and dark at the edges: ſome have appeared uniform and clear as a piece of heated iron, others irregularly bright and like a coal, a part of which was in its full glow, and part burnt to a cynder. In ſome, the light or brightneſs had been ſeen pure, in others troubled, dim, and, as it were, ſmoaky; but the brighteſt, and the pureſt of them, in the moſt favourable obſervations, have never any glittering light. They have nothing of the ſparkling or vivid ſplendor of the fixed ſtars, or of the placid brightneſs of the planets. In ſome of the brighteſt that have been the ſubjects of examination, the middle has appeared much more vivid than the other parts, and the edges have appeared, as it were, of a ſubſtance abſolutely differing from the middle. When the obſervations are continued for ſome time, changes, and thoſe very conſiderable, are diſtinguiſhed in the body of the comet. Its glowing light appears to become ſtronger or fainter, according to the ſtate of the comet with reſpect to the ſun; from an uniform maſs it will ſometimes appear cracked, broken, and divided, and, of the ſeveral parts, produced by that diviſion, ſome will loſe their glowing appearance ſooner than others. There will be all theſe changes

about the centre of the disk, and there will be yet greater toward the circumference. The edges will, in some periods, appear rough, and in other observations the eye loses sight of them, and the whole disk appears much smoother.

These changes have misled many in their observations on the comets, into systems very absurd, and, where we see some favourite system is to be established, it will be well to give but a limitted credit to the appearances as represented by the author of it. Prejudice and prepossession will make people see that which is not, and it will often torture what is seen, to make it answer the purpose. But as to all the alterations of the same comet, or the variety in different comets, mentioned here, they all serve to strengthen, and not to overthrow, the system which declares them to be no other than planets of a peculiar kind: bodies naturally opake and cold, but, at times, coming within the reach of the sun's influence in such a manner as to be violently heated, and afterwards, in their course, by degrees, cooling again.

We shall the less wonder at these changes, which are visible in the bodies of comets, by the assistance of telescopes, if we consider the extreme cold regions from which they come in their approaches to the sun, and the absolute effect of the sun upon them, or the degree of heat which they must acquire in their approach to that luminary, and the length of time proportioned to the degree of that heat, and to their own bulk, which it must take to cool them. The heat of the sun is as the density of his rays, that is, reciprocally as the squares of the distances from his body. The distance of one of the comets from the sun, measured, with the greatest accuracy, was found to be to that of the earth from the sun, at one time, as six to one thousand; this was the comet of 1680, consequently the heat of the sun in that comet, at that time, was to the heat of the sun upon this earth, at midsummer, as eight and twenty thousand to one. The heat of boiling water, carefully examined and compared, appears to be to that of the dry earth heated by the sun, at midsummer, only as about three to one: we may allow the heat of red-hot iron to be three or four times greater than that of boiling water, and thus we shall rise to an idea of something like a knowledge of the heat of that comet at that time: for the proportion on these principles will shew, that the heat of the body of the comet, at that period, when it was nearest to the sun, was two thousand times as great as that of red-hot iron. It appears by computation, on unerring principles, that a globe of iron, of the bigness of our earth, heated red-hot, would be fifty thousand years in cooling: therefore, if we suppose the matter of the comet to cool an hundred times quicker than red-hot iron, yet, since its heat was, at the time of its being nearest to the sun, two hundred times as great as the heat of red-hot iron, supposing it to be of the bigness of this earth, it would be a million of years in cooling.

We have no certain method of determining the absolute magnitudes of the several comets that have been seen at several times; but as to their relative bigness, with respect to one another, there is probability that as those planets which are nearest to the sun, and revolve in least orbits, are the smallest in their diameters; so among the comets we may believe, that such as, in their perrihelion, come nearest to the sun, are the smallest, and those, which are, at that period of their course, the most remote of all from the sun, are the largest, and have the greatest orbits. We may generally judge safely by analogy, and therefore it is probably thus.

It is very singular that there should be, among the astronomers, and those of eminence too, some who argue against the whole system

 of

of comets as revolving round the ſun, and are of opinion, that they only paſs by us in their fall through the regions of ſpace, having no dependence upon our ſun, or connection with our ſyſtem; and that, having been once ſeen, they never return to us any more; yet this is aſſerted by ſome of the moſt eminent amongſt the aſtronomers of a neighbouring nation. The perfection, however, to which the ſyſtem of theſe ſtars has been brought in England, (for it is our own country that claims the merit of this vaſt improvement in the ſcience) has now ſet aſide all ſuch, and indeed all other, objections. We are as perfectly aſſured that the comets are firm and durable bodies, and that they revolve in regular periods about the ſun, as we are that the planets are ſuch bodies, or that they perform ſuch revolutions: the very figure of their orbit is the ſame, as to its general denomination, both the one and the other deſcribing an ellipſis; only the ellipſis of the planets is ſmaller, and approaches more to the figure of a circle being ſhorter, and that of the comet is larger, and immoderately long. It is from this that we ſee the planets in a great part of their courſe, and the comets in very little of it. Their ellipſes are ſo vaſtly excentric, that we ſee them only in a ſmall part of their revolution, and in the reſt of it they are carried away to immenſe diſtances, out of the reach both of our eyes and of our teleſcopes. This is indiſputably their true theory, and there wants only time for obſervations to prove it yet more abſolutely.

It is pretended, that the theory of the comets was better known in very early periods of aſtronomy, than it is at preſent. We have accounts in ſome of the earlieſt Greek and Roman authors, that the Chaldæans were accuſtomed to predict their appearance, which could not be effected without a very perfect knowledge of their laws and revolutions; but it is not at all probable that it was ſo, nor have we any thing more than the aſſertion to ſupport it. We know from all accounts, that the Chaldæans paid great attention to the heavens, and ſet down in their hiſtories whatſoever appeared new or ſtrange in them. Men, who ſpent any time in obſervation, could not but ſee, that theſe were not of the nature of the fixed ſtars, and accordingly we hear it as a part of their praiſe, that they firſt diſtinguiſhed them to have a motion; but that they knew any thing farther of them, or made but the leaſt gueſs, as to the nature, or time of that motion, is highly improbable. They were famous alſo for calculating eclipſes, but it is on no better foundation. Indeed much of the reputation of theſe antient people is owing to the veneration thoſe who have written of them had for antiquity. They have ſaid much more of their knowledge, than they had warrant to ſay. It is with eclipſes, on this head, as with comets; we find the Chaldæans ſet down accounts of them, but that is all; nay, we can, by no means, believe all that is ſaid, even on this head. They appear too numerous in their accounts, and probably the greater part were added to make good their claim to antiquity. But we do not find they ever calculated, or foretold theſe, nor is it likely, for they do not appear to have known even the moon's theory.

COMPAGES CŒLI. An old term which occurs in ſome of the Latin writers, and is uſed to expreſs the Milky Way. This was done in conſequence of an opinion of Theophraſtus, adopted by ſome of the philoſophers, who ſuppoſed that the heavens, being a concave globe, muſt have been formed of pieces, and thoſe faſtened together ſtrongly where they were united. This place of uniting them he called the Compages Cœli, and he took the

Milky

Milky Way to be this place, and appealed to the peculiar brightneſs of it to corroborate this opinion: ſo that with him, and with thoſe who have adopted the opinion, and continued the name from him, the Milky Way was underſtood to be the commiſſure, or joining, of the northern and ſouthern hemiſpheres.

COMPASS. Nothing being ſo determinate as the directions of the ſeveral points of the compaſs, nothing can be more preciſe than the expreſſions of thoſe who ſpeak with regard to them; but nothing is more vague than the common mention of the right and left hand parts of the heavens. In the antients, in particular, it is impoſſible, without certain data, to know what is meant by them, the term right, with ſome, being what is left with others, and ſo vice verſa.

Although there is this contradiction, it is eaſy to be explained, and knowing whence it ariſes, there will be no error. In order to underſtand what a man means by the right hand part of heaven, we are to conſider which way he ſuppoſes the face of the perſon who ſpeaks to be turned. If all had meant the ſame way, all would have expreſſed themſelves in the ſame terms when they meant the ſame part of the ſkies; but although it is otherwiſe, yet, as certain ſets of perſons have always meant the ſame thing, we are to know only to which of theſe ſets the perſon, who writes, belongs, and we ſhall underſtand him.

The aſtronomers, making the great end of their obſervations the time of the ſeveral heavenly bodies coming to the meridian, always look to the ſouth, and in ſpeaking of the part of the heavens on either hand, whether the right or left, they are to be underſtood accordingly. Therefore, when an aſtronomer ſays any phænomenon was in the right hand part of the heavens, we know he means that it was in the weſt, and if he ſpeaks of the left hand part of the heavens, we know that he means the eaſt. On the other hand, the geographers, determining themſelves in preference of that part of the globe which was moſt known, always are to be underſtood as looking toward the north; and, conſequently, when they talk of the right and left hand parts of the heavens, they mean exactly the contrary of what the aſtronomers intend. So that when it is a geographer who mentions the right hand part of the heavens, he means the eaſt, and when he mentions the left hand part, he means the weſt.

But this is not all that is to be conſidered; there are two other ſorts of writers of whom we are to know what they mean by this term, in order to underſtand it; the poets and the ſoothſayers, prieſts and augurs. We frequently meet with the terms right and left part of the heavens in the poets; and as to the augurs, the very eſſence of their art depended upon the quarter in which things appeared. The poets are often interpreters of the augurs, and then they uſe their terms; but when they ſpeak of themſelves, there is the ſame difference between them and the others, as between the aſtronomers and geographers; they mean juſt the contrary of one another by the ſame words.

It was a point of their religion in the augurs always to look to the eaſt, ſo that when they tell you, or, when the poets, ſpeaking for them, ſay, that this bird flew to the right, or that it thundered to the left, they mean, by the right hand part of heaven, the ſouth, and, by the left hand, the northern part: and juſt on the contrary, the poets, when they ſpeak from themſelves, always ſuppoſe the face turned to the weſt, for as the geographers look to the northern part of the world, theſe looked to the fortunate iſlands. With them therefore the

right

right hand part of heaven was the northern part, and the left hand part the ſouth. Thus we ſee, among four different ſets of people, the ſame term ſtanding for eaſt, weſt, north, and ſouth, and conſequently all muſt be confuſion in this reſpect without the clue: but with this ſingle information all is intelligible, and all certain. We muſt conſider who ſpeaks, and we ſhall eaſily underſtand what we hear. We are only to remember that the aſtronomer looks to the ſouth, the geographer to the north, the augur to the eaſt, and the poet to the weſt, and all the reſt is palpable.

COMPLEMENT *of Latitude.* A term uſed by aſtronomers and geographers with reſpect to places diſtant in the north or ſouth from the equator, or, in other words, to all parts of the earth that have any latitude: and it reſpects the general diviſion of the circle. It is that number of degrees, minutes, and ſeconds, which, added to the number of degrees, minutes, and ſeconds, that mark the latitude of the place, make up the number to be ninety. Ninety degrees being known to be the diſtance of the equator from either pole, this conſideration of a complement of latitude will not appear trifling. In the firſt place it gives, at one calculation, the angle which the plane of the equator makes with the plane of the horizon; that is, in other words, it ſhews the height of the equator at that place.

CONE. One of the regularly figured ſolids, in ſhape reſembling a loaf of ſugar. Geometricians uſe the term to expreſs not only any thing material and palpable, but any quantity of ſpace filling the lines of ſuch a figure, and the aſtronomers, taking the term from them, uſe it alſo in the ſame ſenſe. The generation of a cone is this; if we take an immoveable point, elevated at ſome diſtance above the plane of a circle, and ſuppoſe a ſtrait line drawn through the point, and extended both ways from it to an indefinite length, this is the baſis of the figure. This line we are to ſuppoſe carried quite round the circle, all the while touching its circumference, and ſtill fixed at its immoveable point; the line, by this motion, will deſcribe two conic ſurfaces, which are vertical, or oppoſite to one another. The common vertex of both will be at the immoveable point. The ſolid, contained within the conic ſurface, between the immoveable point and the circumference of the circle, above which we marked it as elevated, is a cone; the immoveable point is the vertex of the cone, and the circle itſelf is the baſe; and immediately over it there will ſtand another cone of equal dimenſions. If a ſtrait line be drawn from the vertex to the centre of the baſe, it is called the axis of the cone; and all ſtrait lines, drawn from the vertex to the circumference of the baſe, will be ſo many ſides of the cone. If the axis of a cone be perpendicular to its baſe, the figure is called a right cone; but, if the axis be inclined to the baſe, it is called an oblique, or a ſcalenous cone. But when aſtronomers call any thing a cone, or mention a cone without any farther words, they are always to be underſtood to mean a right cone. Beſide the method already given for the origin of a cone, the ſame figure may be formed another way. The revolution of a right-angled triangle round one of its legs, as upon an axis, will form a cone. In this caſe the fixed leg of the triangle will be the axis, and the circle, deſcribed by the other leg, will be the baſe of the cone.

The cone, thus formed, will be more or leſs acute, as the acute angle, adjoining to the immoveable leg of the deſcribing triangle, is more or leſs acute. The acute angle of a cone is often neceſſary to be eſtimated, and it is to be done in this manner alſo. From the extreme

points

points of any diameter of the baſe, draw ſtrait lines to the vertex. A triangle will be thus formed, and the acuteneſs of it may be meaſured by the angle of this triangle at the vertex. If two cones, of equal diameter in the baſe, are of different length, the longer is more acute than the other. Similar cones are ſuch as have their axis and the diameter of their baſes proportional. Thus all right cones, which have their acuteneſs the ſame, are ſimilar. Alſo vertical cones, whoſe baſes are parallel, are ſimilar.

If a plane be imagined to paſs through all, or any part of the ſides of a cone, the curve line, deſcribed upon the plane by the ſides, is called a conic ſection. If all the ſides of a cone are cut through by a plane, to which the axis is perpendicular, the ſection of the cone is a circle: but if all the ſides of a cone are cut through by a plane, to which the axis is inclined, the conic ſection is then called an ellipſis. An ellipſis, made by the ſection of the ſame cone, or of two cones that are ſimilar, is the more oblong the leſs the angle is which the axis of the cone makes with the interſecting plane. If a cone is cut through by a plane, to which one of the ſides of the cone is parallel, the ſection is called a parabola. If a cone is cut through by a plane, to which one of the ſides of the cone is inclined in ſuch a manner that the plane, and the ſide extended both ways from the baſe of the cone, would meet in a point beyond the vertex of it, the ſection is called an hyperbola. When two cones are placed on one another, top to top, they are called vertical.

CONSEQUENT ANGLES. A term uſed by aſtronomers to expreſs two angles, which have one of their two legs in common to both. Thus, if a perpendicular line be let fall upon an horizontal one in any part of its length, there are two angles formed which have the perpendicular line, as a leg in common to both. Howſoever unequal the two angles formed by this common leg be to one another, the ſum of the quantity of both is equal to that of two right angles made by the ſame lines, this follows from their being conſequent. *See* ANGLE.

CONSTELLATIONS. Certain imaginary figures of birds, beaſts, fiſhes, and the like in the heavens, under the out-lines of which aſtronomers have collected certain ſtars, in order to the ſpeaking regularly of them with regard to their places in the heavens.

The fixed ſtars, although they are not by a great deal ſo numerous as might naturally appear to an unexperienced eye, are yet ſo many and ſo irregular in their ſituation, that it would be impoſſible to treat of them without ſome ſort of arrangement; and by the diſpoſing them in this manner, in ſome part of the figure of an animal, or whatſoever elſe, they may be regularly and intelligibly ſpoken of, with reſpect to their ſituations or places, in regard to one another, and be treated of with the greater facility.

Among other figures, the reverence of early times for certain perſons, whom enthuſiaſm had ſpoken of as carried up into heaven, led them to ordain their repreſentations for the receiving of certain ſtars: animals, and even things inanimate, which the fabulous ſtories of thoſe times had afterwards ſuppoſed removed into the ſame regions, on particular occaſions, became added to thoſe, and, by degrees, the heavens were fully ſtored with theſe imaginary ſigns and lineaments.

It was very early in the ſtudy of aſtronomy, that the fixed ſtars were diſtributed into ſix claſſes, according to their different bigneſs, and ſoon after catalogues were made of them, deſcribing their magnitude according to theſe claſſes,

classes, the largest being called stars of the first magnitude, and so of the rest, down to the sixth; and in these catalogues their situation in longitude and latitude was laid down. It is owing to these catalogues that we can apply the antient observations to use, by comparing them with the modern; and this would have been impossible without the assistance of the prior arrangement of the stars into constellations: since without this it would have been impossible for them to have spoken of them intelligibly.

The first or earliest of these catalogues, of which we have any knowledge, is that of Ptolemy, this is given in the seventh book of his Almagest, and he prepared it, as he assures us, from his own observations, compared with those of Hipparchus, and the other antient astronomers. Ptolemy, in this catalogue, has formed forty-eight constellations. Of these, twelve are about the ecliptic, twenty-one to the north, and fifteen to the south. The northern constellations are, the Little Bear, the Great Bear, the Dragon, Cepheus, Bootes, the Northern Crown, Hercules, the Harp, the Swan, Cassiopæia, Perseus, Auriga, Ophiucus, or Serpentary, the Serpent, the Arrow, the Eagle, the Dolphin, the Horse, Pegasus, Andromeda, and the Triangle.

The constellations about the ecliptic are Aries, Taurus, Gemini, Cancer, Leo, Virgo, Libra, Scorpio, Sagittarius, Capricorn, Aquarius, and Pisces: according to the English names, the Ram, the Bull, the Twins, the Crab, the Lion, the Virgin, the Balance, the Scorpion, the Archer, Capricorn, the Water-Carrier, and the Fishes.

The constellations which Ptolemy has described to the south are, the Whale, Orion, the Eridanus, the Hare, the Great Dog, the Little Dog, the Ship, the Hydra, the Cup, the Raven, the Centaur, the Wolf, the Altar, the Southern Crown, and the Southern Fish. These are the celestial signs according to Ptolemy and the antients.

When the ecliptic was divided into twelve equal parts, each containing thirty degrees, they assigned to each of these intervals one of the signs. They gave it the name of the constellation, which was at that time in that part, excepting with regard to Libra, the stars composing that were in the constellation Scorpio, which occupied the space of two signs.

In order to make one constellation answer to each sign, they afterward proposed to withdraw a part of the Scorpion, and in the place of that portion of the extent of it, to place the figure of Julius Cæsar with a balance or scales in his hand, in the manner as we see the figure of that emperor in some bass-reliefs, and on engraved gems preserved to this time. This is the explanation of that passage in Virgil, in which the poet expresses the Scorpion as drawing in his arms, and retreating a little way to make a place for that hero in the heavens.

However, Ptolemy, and a great many of the old astronomers, call those stars which we express by the term Libra, the claws of the Scorpion, Chelæ and Forcipes Scorpionis; and we find them marked in the old manner in Copernicus's tables of the fixed stars. In the Alphonsine tables, however, they are called the stars in Libra, and referred to under the lineaments of that figure; and so Tycho has placed them; and so they are now in general received.

Beside the stars regularly comprised in each of the constellations, Ptolemy has taken notice of those others which are in different parts of the heavens near and about them, and which not being comprehended within the lines of those figures, are called unformed stars, or by some inform stars. He has determined the longitude of all these stars, and their latitude

for

for the beginning of the reign of Antonine, which is about the year 137. The ſtars thus deſcribed amount to the number of one thouſand and twenty-two, and of theſe three hundred and ſixty are in the northern part, three hundred and forty-ſix about the ecliptic, and three hundred and ſixteen to the ſouth.

Among the modern aſtronomers Tycho Brahe is the firſt who determined, with exactneſs, and in conſequence of his own obſervations, the longitude and latitude of the fixed ſtars, out of which he has formed forty-five conſtellations. He adds to thoſe, deſcribed by Ptolemy, the Coma Berenices, which comprehends the unformed ſtars about the tail of the Lion; and Antinous, formed out of thoſe which are about the Eagle; but he omits five of thoſe to the ſouth, viz. the Centaur, the Wolf, the Altar, and the Southern Crown and Southern Fiſh: theſe he could not make the ſubjects of his obſervations, becauſe of the too great elevation of the pole at Uranibourg.

After Tycho, Bayer gave the figures of ſixty conſtellations very exactly done, and with tables annexed. Forty-eight of theſe are the ſame with the conſtellations of Ptolemy, and the additional twelve thoſe which had been diſcovered after his time toward the ſouth pole. He has very accurately marked the bigneſs and the ſituation of every ſtar mentioned in the antient catalogues of the forty-eight conſtellations of Ptolemy, and he has marked each ſtar by a letter in the Greek and Roman alphabets. This was a very happy thought, for ſuch an agreed character being allowed as the mark for each ſtar, aſtronomers could treat of them with as few words as if they had each its ſeveral name; and they have all adopted it. Wherever we ſee a letter after the mention of a ſtar in any of theſe writers, the meaning of it is, that it is the ſtar marked by that letter in Bayer's catalogue. Bayer has, in theſe tables, been of vaſt ſervice to the aſtronomical world.

With reſpect to the twelve conſtellations, which are toward the ſouth pole, he has been leſs preciſe or large upon them: he has repreſented them all in one plate with the ſtars they comprehend; but he has ſaid nothing of their number, or of their ſeveral magnitudes. They are called the Peacock, the Toucan, the Crane, the Phœnix, the Dorado, the Flying Fiſh, the Hydra, the Chamelion, the Bee, the Bird of Paradiſe, the Triangle, and the Indian.

In the twenty-one conſtellations of the northern hemiſphere there are ſeven hundred ſtars, only three of which are of the firſt magnitude, twenty-five of the ſecond, eighty-one of the third, an hundred and fifty-one of the fourth, an hundred and five of the fifth, and one hundred and thirty-four of the ſixth. To theſe we are to add two hundred and one unformed ſtars about the ſeveral conſtellations, and we have the full number. About the ecliptic he has given four hundred and forty-five ſtars; of theſe, five are of the firſt magnitude, and there are eleven of the ſecond, fifty-one of the third, eighty of the fourth, one hundred and twenty-one of the fifth, one hundred and thirty-two of the ſixth, and forty-five unformed ones.

And, finally, in the twenty-ſeven conſtellations to the ſouth, he counts five hundred and ſixty-one ſtars; of theſe, nine are of the firſt magnitude, and twenty-ſeven of the ſecond. There are alſo ſixty-four of the third magnitude, an hundred and eighty-four of the fourth, an hundred and twenty-two of the fifth, twenty-five of the ſixth, and eighty unformed ones. So that all the ſtars, mentioned by this author, taken together, amount to one thouſand ſeven hundred and ſix, of which ſeventeen only are of the firſt magnitude, and there are ſixty-three of the ſecond, an hundred and ninety-

ninety-six of the third, four hundred and fifteen of the fourth, three hundred and forty-eight of the fifth, three hundred and forty-one of the sixth, and three hundred and twenty-six unformed ones. These are all the ſtars viſible to the naked eye. When we caſt up our eyes toward the ſky in a clear night, their uncertain ſituation, and their twinkling luſtre, deceives, for we ſeem to ſee them innumerable, but, in reality, what we ſee are thus limitted.

Thus ſtood the ſtate of aſtronomy with reſpect to the doctrine of the fixed ſtars to that time: it has ſince that been vaſtly improved. The uſe of teleſcopes has diſcovered ſuch multitudes of ſtars that are not viſible to the naked eye, that they are become innumerable. But before we proceed to this, it is proper to conſider the intermediate time between thoſe days and our own, in which the ſtudy is thus advanced.

After Bayer, we find a catalogue of the fixed ſtars by Schiller, it is publiſhed in 1627. The ſtars are here diſpoſed in the lineaments of certain figures, but not the ſame which Bayer, to avoid confuſion, had continued from the days of antiquity. The author calls his work Cœlum Stellatum Chriſtianum, the Chriſtian Starry Heaven, and he ſubſtitutes to the antient and profane names of the conſtellations, names taken from ſacred hiſtory. But this, as it would bring in perplexity and confuſion, and could be of no real good, has been rejected by all the ſucceeding aſtronomers.

In the year 1665 the accurate and faithful Riccioli publiſhed his Aſtronomy Reformed. He gives, in this work, a catalogue of the fixed ſtars, of which he has formed ſixty-two conſtellations, comprehending in the account the Coma Berenices, and the Antinous of Tycho, for the collecting of the before unformed ſtars of that part of the heavens. He has diſtributed the ſtars contained in theſe conſtellations into four claſſes. In the firſt of theſe are contained thoſe ſtars which he had determined by his own proper obſervations, and thoſe of Grimaldi. In the ſecond are comprehended thoſe ſtars which had been aſcertained by Tycho Brahe, or Kepler. In the third are contained the ſtars determined by Hipparchus and Ptolemy. And the fourth conſiſts of thoſe of the ſouthern hemiſphere diſcovered by navigators, who have aſcertained, in a more or leſs accurate manner, their places; and he has marked their longitude and latitude for the year 1700, which is the period to which he has reduced all his obſervations. This catalogue, in which there is great merit, not only with reſpect to the exactneſs of thoſe obſervations that were made by the author, but with regard to the different degrees of exactitude in other caſes, was followed by a number of celeſtial ſchemes and maps of the heavens publiſhed in 1673 by Pardies, who has repreſented, very carefully, all the conſtellations, with the ſtars they contain. After this, Jerom Vitalis publiſhed a catalogue of the fixed ſtars in his tables of the Primum Mobile. In this are marked the longitude and latitude, with the right aſcenſion and declination of the ſtars for the year 1675.

Sometime after this Auguſtine Royer publiſhed maps of the heavens, reduced into four tables, with a catalogue of the fixed ſtars for the year 1700. He gives in theſe the longitudes and latitudes of the ſeveral ſtars marked by Bayer, the ſituations of which had been calculated by Chartreux; and he adds a number of ſtars not before ſeen, and others taken from the tables of Riccioli, and not mentioned by Bayer. Beſide all this care and exactneſs, Royer has formed out of the ſeveral unformed ſtars eleven other conſtellations. Five of theſe are to the north, and are called the Giraffe, the River Jordan, the River Tigris, the Sceptre, and the Flower-de-luce; and ſix on the ſouth part,

part, which are called the Dove, the Unicorn, the Crofs, the Great Cloud, the Little Cloud, and the Rhomboide. The ftars which Bayer has defcribed are one thoufand eight hundred and fix; fifteen of thefe are of the firft magnitude, fixty-two of the fecond, two hundred and eighteen of the third, five hundred and four of the fourth, four hundred and feventy-nine of the fifth, five hundred and thirteen of the fixth, and fifteen nebulous ftars. He has joined to his work the catalogue of the fouthern ftars, which Halley obferved, with great attention, in the ifland of St. Helena, to which place he went exprefs, for the determining their fituation.

Hevelius has alfo improved upon the labours of thofe who went before him, and collected together feveral ftars of the before unformed clafs into fome new conftellations. Thefe are the Unicorn, the Camelopardalis, defcribed by Bartfchius, the Sextant of Urania, the Dogs, the Little Lion, the Lynx, the Fox and Goofe, the Sobiefki's Crown, the Lizard, the Little Triangle, and the Cerberus; and to thefe Gregory has added the Ring and the Armilla.

Some of thefe new conftellations, however, anfwer to thofe of Royer, as the Camelopardal to the Giraffe, the Dogs to the River Jordan, and the Fox to the River Tygris; and he has given alfo for the year 1700 the longitude and latitude of all the ftars, except thofe about the fouth pole. Thefe are laid down with great exactnefs.

In fine, Flamftead has given a catalogue of the fixed ftars, not only much more correct, but much larger than thofe of all that have gone before him. He has marked the longitude, latitude, right afcention, and diftance from the pole of a multitude of ftars, as they were at the beginning of the year 1690, which he has determined by his own proper obfervations. He diftributes all the ftars into feven claffes, according to feven degrees of magnitude, diftinguifhing thofe of Bayer by the letters by which they were marked by that author, and he has marked their variation in right afcention, in order to the finding their fituation in the fucceeding years.

This catalogue was followed by an Atlas Celeftis publifhed in London in the year 1729, in which there are defcribed, in feveral fchemes, the figures of the conftellations feen in our hemifphere, with the exact pofition of the fixed ftars, with refpect to the circles of the fphere, as refulting from the laft catalogue corrected by Flamftead. In this manner has the ftudy of that part of aftronomy, which refpects the fixed ftars, been improved from time to time, till it is now, in a degree of perfection, fufficient to anfwer the feveral purpofes of the aftronomer in a degree of accuracy which will never be much exceeded. It began very early. For there are no books fo antient in which not only the heavens are confidered, or but ever fo flightly mentioned in this refpect, but we find them treated of as diftinguifhed into conftellations. Hefiod mentions feveral of the conftellations familiarly by the names by which we now know them; and Homer calls them by the fame. We find Orion and the Pleiades mentioned alfo in the book of Job; and there is hardly an author of antiquity who has not talked of them.

It has been often attempted to alter the names of the conftellations, but it is an idle and ufelefs defign. The venerable Bede was the firft perfon whom the heathen names offended; he changed the twelve figns of the zodiac from their heathenifh characters, and called them by the names of the twelve apoftles; and Schiller, whom we have already mentioned, borrowed from him his fcheme of new naming them all. Aries was converted

into St. Peter opening the gates of heaven, Taurus into St. Andrew, and ſo the reſt.

Nor was the deſign of marking out the particular ſtars, of which the conſtellation conſiſted, or ſome in particular of them which were moſt conſpicuous, or moſt likely to be referred to in diſcourſe, or writing, by certain parts of the animal under whoſe figure they arranged them, all that induced the antients to allot the peculiar figures they have aſſigned for the delineation: they had, in many things, reaſons which are not common to us, and it was ſo in this.

Cancer and Capricorn, a Crab and a wild Goat, were the creatures they choſe for giving form to the conſtellations, or arrangements of thoſe ſtars, which, according to their language, made the barriers of the ſun's courſe. The Crab is an animal, of all others, the moſt ſingular in its motions. It goes not ſtrait forwards, as other creatures, but ſideways, or obliquely, and backward. This was their choice therefore to expreſs that the ſun, when he came into that part of the heavens, began to go retrogradely, and to deſcend obliquely. The reaſon of the wild Goat's being choſen for the other, is not leſs obvious, the character of the animal is to be continually climbing; as it feeds it is always aſcending ſome mountain, and it browzes as it goes on all the way, higher and higher to the top of the aſcent. They uſed this animal as the figure under which to arrange thoſe ſtars, at which, when the ſun arrived, he began to quit the lower part of his courſe to attain, by degrees, the higher. It is plain therefore, that while we have ſuppoſed all this choice of animals among the antients to be fancy, and have arraigned them of impropriety, at leaſt of wildneſs in it, there was a great deal of meaning and intent in it; they evidently meant, by the figures which expreſſed theſe two ſigns, at which the ſun is found in the two ſolſtices, to expreſs, by a ſymbol, and in a ſuccinct and clear manner (and, at the ſame time, to do it in ſuch a way that it ſhould be fixed upon the memory) what it was that happened in the courſe of nature at the time when the great luminary of the heavens arrived in theſe places. We have the teſtimony of their own authors that this was the intent with which they did this: and it is unreaſonable and abſurd to doubt of their having had a like reaſon for all the reſt of their choice, although it does not happen to be as punctually named to us. There is all the reaſon imaginable to believe that they ſelected the other ten conſtellations, at leaſt, of the zodiac, to expreſs in this manner what paſſed in the courſe of nature upon the earth from time to time, as the ſun entered one or the other of thoſe parts. But, in order to enquire properly into this, we are firſt to inform ourſelves of what were the original ſigns or figures, for they were not altogether the ſame with thoſe at preſent; and it would be idle indeed to expect to find the meaning of the inventors of theſe figures, in figures which they did not apply to the purpoſes. We know that the Romans were the authors of the conſtellation Libra, and it would be abſurd to expect that we ſhould find the meaning of the inventors of the ſigns of the zodiac under that form. They placed Julius Cæſar with a balance in his hand, as we ſee him repreſented on many antiques in that part of the heavens, arranging under that form thoſe ſtars which had before been in the claws of the Scorpion, the Scorpion of old times occupying the place of two ſigns. We find one of their poets complimenting Cæſar on the honour which they did him in thus taking him up among the ſtars:

Ipſe tibi jam brachia contrahit ardens
Scorpius et cœli plus juxta parte reliquit.

They did this as an honour to their emperor, and by way of regularity, that every ſign of the zodiac

zodiac might have a constellation annexed to it, not one of them, as was the case in this, taking up two signs.

In the same manner we find among the Greeks (who are indeed the people that established astronomy in the world, for every thing before them was wild and uncertain) the figures of the two brothers, Castor and Pollux, for the third sign in the zodiac. The Greeks, altho' they improved and advanced astronomy to that great pitch at which we see it in the second period, yet received its principles, and took the rudiments of it, from the Egyptians. This is an undoubted truth; themselves acknowledge it, and, although they did not, the general testimony of the world at their time would prove it. The Egyptians, it is certain, were the inventors of the zodiac, and were the people who adapted the constellations to its several parts; but what could the Egyptians know of Castor and Pollux, these make up the sign Gemini, the third of the zodiac, and these, before they were exalted to this place in the heavens, we are told, were the two sons of Leda, wife of a Laconian king. The Greeks might reverence the descendents of Tyndarus, and they might wish to immortalize the princes of their country, who had accompanied Jason in his voyage to Colchis, and rescued Helen from the arms of Theseus. But what could the Egyptians, who formed the constellations of the zodiac, know of Persons, who are said to have been born many ages after the time of their making this distribution of the heavens? The Roman Libra, and the Grecian Gemini, therefore, would greatly perplex and mislead us in the pursuit of what was meant by the original choice of the figures which were given to the zodiac constellations; since they were not the original figures; nay, and were given by those who had no knowledge of the intent with which the others had chosen those which were such. When we trace up the origin of the constellations to the early Egyptians, we give them their birth among a people who used the hieroglyphic language; a people with whom it was the custom, on all occasions, to represent their sentiments, not by letters and words, as we do, but by the figures of animals, and other things, whose natural properties and qualities corresponded with what they had to express. It is therefore, on all accounts, probable, that they had the same design in those figures, under the lineaments of which they comprised the stars which answered to certain parts of the zodiac, and belonged to certain of the seasons. It was natural they should intend to do this, and they had all the opportunity imaginable for it, since those stars might as well be comprised under one form as another.

Having found then that Gemini, for instance, could not be the original figure of that part of the zodiac where it now stands, let us inquire what was the antient constellation, before we attempt to assign the occasion of its being made so. Herodotus expresly tells us, that the very names of these brothers were not known among the Egyptians of a much later date than the time of those who formed the constellations of the zodiac: and, on inquiry, we find that the original constellation for this place, although it did represent two figures, did not make them men, but kids, or young goats. The Ram and the Bull are indisputably the authentic figures of the earliest times, and we find, on this inquiry, that the true constellations of the spring of the year were, originally, a Ram, a Bull, and two Kids. It remains to inquire, for what particular reasons these animals were chosen preferably to all others, and what these hieroglyphical writers

meant to inſcribe under their characters in the heavens. Commerce was among the earlieſt ſubjects of man's application, and the earlieſt articles of commerce were thoſe flocks and herds which he nouriſhed. If we look into the ſacred, as well as into the earlieſt of profane hiſtory, we ſhall find the riches of the antient world contained in theſe creatures. So many ewes, ſo many oxen, and ſo many ſhe-goats, is the uſual method of ſaying what were the poſſeſſions or riches of a patriarch, as regularly as ſo many thouſands are ſpoken of ſince the uſe of money, to denote the fortune of the poſſeſſor. While theſe were the great care of the earlieſt people, and made their immediate riches, it cannot be doubted but they were a principal object of their attention. It was, in a great meaſure, for the ſake of theſe that they remarked the periods and ſeaſons of the year, and it was from theſe they named the conſtellations which marked the times of their increaſe. Autumn is the ſeaſon at which the ſeveral kinds of domeſtic animals, in general, conceive; and ſpring is that, when the young are brought forth, or, if brought forth ſooner, it is the ſeaſon when they begin to feed and ſtrengthen from the growing paſturage. The earlieſt of theſe is the lamb, the ſecond in time the calf, and the third the kid; the ſheep uſually bringing forth her young before the cow, and the cow before the goat. The conſtellations, through which the ſun paſſed in ſucceſſion during the ſpring-time, were marked from theſe animals. When he entered Aries the huſbandman knew his lambs would begin to follow the ewes, and that they would have ſome good weather: when he entered Taurus, the calves would grow ſtrong; and when he came into the third ſign, which, with them, was not two heroes, but two kids, that the young of the goats would follow. If they placed two of theſe for the conſtellation, and only one of each of the other animals, it was, becauſe the goat often brings forth two at a time, the others uſually one.

The fourth of the conſtellations of the zodiac is the Cancer explained already, the ſign by which they expreſſed the retrograde and oblique motion of the ſun. The fifth is the Lion. The heat and fury of the burning ſun, when he has gone from Cancer, could not more naturally have been expreſſed, by any of the animals, than by the Lion, the moſt furious. The ſucceeding conſtellation, the ſixth in order, received the ſun at the time of ripening corn and approaching harveſt: by what could they better expreſs this, than by one of the female reapers with an ear of the reddening corn in her hand. This is Virgo the maid, the name by which ſhe was called among the old aſtronomers. Erigone alludes to this, the meaning of it is reddiſh, or tawney. It might poſſibly be given to repreſent the tanned complexion of the reaper, but it is more probable that they intended to ſay by it, the corn grows brown, or reddiſh, and is preparing for the ſickle. We are to examine why they characteriſed the ſucceeding ſtars under the figure of a Scorpion. They gave to this creature not one, but two, of the twelve diviſions of the zodiac. Autumn, which affords fruits in vaſt abundance, affords the means and cauſes of diſeaſes, they follow quick behind it, and the ſucceeding time is the moſt unhealthful of the year. This was the ſentiment they intended to expreſs by the figure under which they arranged the ſtars of this conſtellation. They have placed the moſt venemous and terrible of animals here ſpreading out his long claws into the one ſign, as threatening miſchief, and in the other brandiſhing his tail to denote the completion of it. The one threatens miſchief, nay, threatens to draw men into it, the other ſhews the conſequences.

The fall of the leaf was the ſeaſon of the antient hunting; that hunting which had not for

for its game ſome weak defenceleſs animal, which it is cruel to deſtroy, and which, when deſtroyed, will ſcarce afford the family one meal. The objects of their chaſe were the wolf, the tyger, and the other large and terrible animals that deſtroyed their flocks and themſelves. They arranged the ſtars, which marked the ſun's place at this ſeaſon, into the conſtellation Sagittary, a huntſman with his arrows and his club, the weapons of deſtruction for the large creatures he purſued. Capricorn has been explained already.

There yet remain two of the ſigns of the zodiac to be conſidered with regard to their origin. The winter is a wet and uncomfortable ſeaſon, the fields are bare, the flocks muſt be fed, but they do nothing, the chace is no longer comfortable for the rains: they expreſſed this by their Aquarius, a figure of a man pouring out water from an urn. The laſt of the conſtellations was Piſces, a couple of fiſhes, not looſe and at liberty, but tied together: fiſhes that had been caught. The leſſon was, the ſevere ſeaſon is over, your flocks do not yet produce to you in abundance, but the ſeas and rivers are open. The fiſh will ſupply the place of the fleſh for the table, and may be exchanged for commodities of other kinds. Now is the ſeaſon for your employing yourſelf in taking them.

The conſequences of this explication of the ſigns of the zodiac, and the reaſons why they were choſen to repreſent the courſe of the ſun preferably to other figures, leads farther than might at firſt have been imagined. We not only ſee by it that the aſſignment of theſe ſeveral parts of the heavens to thoſe particular animals, was not the mere work of fancy, but had meaning and inſtruction in it; but we ſhall be brought by it to underſtand where, and in what part of the world this great thing was done. That the Egyptians were the people who taught this diviſion of the zodiac to the reſt of the world is moſt certain; nor is it leſs ſo, that they were acquainted with that diviſion under theſe very forms from their earlieſt antiquity: we find the figures of Cancer and Capricorn, and of the Leo, Virgo, Sagittary, and the reſt, on the oldeſt of their monuments. It is impoſſible, however, from the very nature of things, that Egypt ſhould have been the place where they were invented; for although they anſwer to the ſeveral ſeaſons of the year, and the courſe of human affairs in the ſeveral regions of the temperate zone, it is otherwiſe toward the tropics, and under the torrid zone: it was therefore ſomewhere in the temperate climates that they were invented. In Egypt they ſow in November, and reap their harveſt in March or April; now the conſtellation Virgo, which, by the ears of corn in her hand, indiſputably and plainly denotes the harveſt time, anſwers to Auguſt and September. The watery conſtellation for the winter, although in other places very proper, could have no meaning in Egypt, where they have no rains at all, and where the winter is a very pleaſant ſeaſon. The Egyptians were not natives of Egypt, but ſtrangers, who were induced by the fertility of the country to ſettle there. They were ſettled in that place from a very early period, and they continued there their obſervations of the heavens, nor did they alter the names which their fathers had given them, although in that place they had loſt the ſtrength of their original expreſſion. It is certain, that they uſed in Egypt thoſe figures, and thoſe names which had been eſtabliſhed for that purpoſe in ſome other place: and if we trace this back to its ſource, we ſhall bring aſtronomy to a very early origin, and find the diviſion of the zodiac in particular was made, and theſe figures applied to the ſtars, which belonged to its ſeve-

ral

ral portions in the plains of Shinar. It was from hence the Egyptians were ſent to people the borders of the Nile, and they went thither very early. It was hence indeed all the kingdoms of the earth were peopled. The early deſcendants of Noah were undoubtedly the people, and that part of the world where they met to erect the tower of Babel, was the place where obſervations of the heavens were firſt made after the flood, and where the names were given to the conſtellations of the zodiac. The ſtory of the deſcendants of Seth being ſkilled in aſtronomy before the flood, is what we can have no proof about, and the relation of the pillars they erected to perpetuate their diſcoveries, and which are ſaid to have eſcaped the deluge, one of them at leaſt (although ſupported by all that Joſephus, fond to make the antient Jews the inventors of all things, could ſay in its favour) is abſurd and chimerical. But this traces up the invention of the conſtellations very high, and with all the probability of which ſuch a ſubject is capable. The courſe of the ſun muſt neceſſarily be remarked by people of all places, as the only means of regulating their affairs, and moſt important concerns. This could no way be done ſo well as by marking out the ſtars, among which it was ſeen at ſeveral times. It was natural to divide theſe into ſome number of equal portions, and the motions of the moon naturally directed it into twelve. Thus the heavens became divided into twelve parts; theſe parts were marked with certain figures, under the lineaments of which the ſtars were deſigned, and the names of theſe became ſo many ſingle words, expreſſing the ſeaſons. The general courſe of the ſun, and the great concerns of mankind, dependant on that courſe, were thus expreſſed by twelve words; and we find, that all nations of the earth were in the earlieſt times acquainted with theſe, all uſing the ſame. This, among other things, may ſerve as a great proof of their being deviſed, when all mankind formed but one people.

The figures of the conſtellations may, however, appear ill choſen, and it is not to be diſputed but more proper ones might have been ſelected. But we are to conſider, that the world was in its infancy of knowledge when this great work was attempted, and there has been more reaſon, than many perhaps are aware of, for not changing them. Beſide the idleneſs of Schiller, and the weakneſs of Bede's ſcheme, they wanted the ſtrong and ſtriking particularities that appear in the old method. It is true, that the diſpoſition of the ſtars has ſo little relation to the ſeveral figures into which they are thrown in the conſtellations, that they might as eaſily be arranged into many others; but yet if a man of genius was to take the tables of the ſeveral ſtars, and putting out the outlines of the figures to arrange them under others, he would probably looſe as much in the art of marking the particular ſtars, as he would gain in the propriety of his figures. We ſee that Julius Cæſar, and a pair of ſcales, were very early put into the place of the claws of a Scorpion in the zodiac, and they anſwer juſt as well. We find Hevelius making that a couple of dogs which Royer had formed into the river Jordan; and it muſt be confeſſed, that the ſtars do juſt as much repreſent the ſcales as the Scorpion, and the dogs as the water, but ſtill they may be more uſefully repreſented by one than by the other. It is equally certain, that the Bull, for inſtance, might as well be repreſented by a pair of wings, or an altar, the ſtars as much repreſenting the one as the other; but ſtill there would want ſomething in point of utility, for the Bull, like the other of the antient conſtellations, is ſo contrived as to take in the ſtars of the

the greateſt magnitude, and ſuch as being moſt conſpicuous would be moſt likely to be ſpoken of, into the parts of the figure eaſily named. Thus in the Bull, there are two remarkable ſtars which ſtand for his two eyes, and are eaſily diſtinguiſhed by thoſe who write of them under the name of the Northern and Southern Eye, and two others are at the tips of his two horns; theſe alſo are particular ſtars which there may be occaſion to refer to, and they, like the others, are eaſily mentioned under theſe names.

We may ſee how dangerous it is to attempt any innovations with regard to the figures of the conſtellations, if we only recollect what great perplexity has ariſen from thoſe very little changes which the antients ventured to make with reſpect to them. It never came into their heads to alter the figures themſelves; they only ſometimes placed the ſeveral ſtars in different parts of the ſame figure, and we are perplexed enough to underſtand them. Indeed if the oldeſt authors in this ſcience had met with the fortune to have their works preſerved to us, we ſhould have probably found a vaſt deal of this; but Ptolemy is the earlieſt we refer to, and he is one of the laſt of the correctors.

The ſchemes of the heavens ſeem at firſt to have been very rudely drawn, and very little regard had to the proportion of the figures; and thoſe writers who publiſhed from time to time on the ſubject, differed from one another when ſpeaking of the ſame ſtars, as to the part of the figure under which to refer to them. Ptolemy tell us, he has ventured to depart greatly from the determinations of Hipparchus in this reſpect, and particularly inſtances it in the ſign Virgo. Thoſe ſtars which Hipparchus alludes to, as placed in her ſhoulders, he tells you he calls the ſtars of her ribbs, and grounds the variation on their being too far from her head, in proportion to the general dimenſions of the figure. We find a difference in the places aſſigned to the ſame ſtars by the different antient writers, which would much perplex us if we did not take this conſideration along with us, and know that they mean the ſame with one another, although they have, for the ſake of propriety, altered their place in the figure.

One of the earlieſt uſe of the conſtellations was the dividing the night by their poſition, their riſing or ſetting. The oldeſt of the Greeks mention this; and it is evident, that it was in practice at the time of the Trojan war: the ſoldiers, in this expedition, divided and ordered their ſeveral watches by the riſings and the ſituations of the ſtars, and this not of ſingle ſtars, but of ſtars as formed into conſtellations. We have even very early accounts of the manner in which this was done. Sun-ſet they obſerved at the beginning of the night, and the ſun being always in one of the twelve ſigns of the zodiac, they knew from a computation of his place what muſt be the ſituation of the reſt, and in what ſucceſſion they muſt riſe.

The property and uſe of the early arrangement of the fixed ſtars into conſtellations, or aſteriſms, is not more evident than the advantage which the ſcience of aſtronomy has received, and the great facility that has been added to its reſearches, by the addition of thoſe new ones, which have, from time time, been thrown into the ſphere, comprehending greater or leſſer numbers of thoſe unformed or looſe ſtars, to which it was before difficult to refer, as they were not compriſed under the lines of any of the old conſtellations, nor could be ſpoken of ſo diſtinctly as thoſe which might be named as belonging to ſome part of this or that figure.

Thus, between the Swan and Dolphin, were a vaſt number of ſtars, which Hevelius has made a conſtellation under the name of the

Fox and Goose, and behind the tail of the Swan was another cluster, so remote from any other, that there was great perplexity in naming them, and these the same author formed into the Lizard. I wish it could be said that Hevelius's figures were always as well chosen as they might have been, or that they comprised as many stars as they ought, but still they were very useful. This consideration, and the observation of the several vacant spaces still left in the heavens, in which were clusters of stars aptly enough joined together by nature, and too remote from any other figure to be named without perplexity, have induced me to offer a farther addition of new constellations, made out of these unformed stars. There are fourteen of these, the names of which will be found in the several parts of this work, and their figures in one or other of the plates. To name them all together, they are the Anguilla, the Limax, the Uranoscope, the Hippocampus, the Gryphites, the Dentalium, the Buso, the Aranea, the Lumbricus, the Scarabæus, the Pinna, the Patella, the Manis, and the Testudo.

The Eel comprehends a great number of stars between the Eagle and Capricorn, and extends from Aquarius to the hand of Ophiucus. A vast length of sky well spangled with stars which were before very difficultly referred to. The Limpet, or Patella, comprises four very conspicuous stars forming a cluster by the shoulder of Ophiucus, and the Pinna Marina, a cluster of seven others, very considerrable ones, between the tail of the Serpent and the feet of the new constellation Antinous. The Gryphite comprehends a very conspicuous set near the arm of Hercules, and the Uranoscope a whole series that are between the belly of the Lynx and the heads of Gemini. The Manis stretches its long form through a great extent left vacant of constellations, though very full of stars between the constellations Cassiopeia, Cepheus, Draco, and Lacerta. The Snail takes in several that are under the beginning of Eridanus, and before the Hare, and the Hippocampus a great many that were left unformed, though often necessary to be referred to, under the feet of Taurus. These occupy the space between that sign and the Eridanus, and are terminated, one way, by the shield of Orion, and the other by the head of the Whale. Between the back of the Whale also, and the lower fish of the constellation Pisces, stands a great space occupied by several conspicuous stars, but with no constellation. The Tortoise is now placed there; and the series of stars, between the shoulder of Aquarius, and the extended hand of Antinous, are comprehended, under the figure of the Dentalium, or tooth-shell. The Toad takes in several conspicuous stars under the sign Libra, and over the Centaur; and a little cluster, of very bright ones, between the Scorpion and the Serpent, are comprehended under the outlines of the Beetle. Between the back of the Hydra and the Spike, or ear of corn, in the hand of Virgo, are a cluster very happily taken in under the figure of the Spider, and the Worm, which crawls up between Cancer and Gemini, also take in a very fair series.

These are the figures which will be found added to the scheme of the heavens in this work; if they are approved by astronomers, it will be a pleasure to me to have added something to the science, if they are neglected, the harm is not much: they take up but a few pages of the work in the description; and in the plates, the stars of which they are composed must have been marked where they are, whether or not they were connected by the dotted out-line which arranges them under this form.

The

The number of ſtars, obſerved in the ſeveral conſtellations, has been greatly increaſed from the times in which they were firſt deſcribed. It may not be amiſs to lay down, at one view, the earlieſt accounts, and the ſucceeding additions. In the Little Bear, Ptolemy obſerved eight ſtars, Tycho Brahe reduced the number to ſeven, Hevelius increaſed it to twelve, and Flamſtead to four and twenty. To the Urſa Major, or Great Bear, Ptolemy allowed thirty-five ſtars, Tycho reduced the number to twenty-nine, Hevelius made it ſeventy-three, and Flamſtead eighty-ſeven. In the Draco, or Dragon, Ptolemy mentions thirty-one ſtars, Tycho makes them thirty-two, Hevelius forty, and Flamſtead eighty. In Cepheus, Ptolemy gives thirteen ſtars, Tycho only four, Hevelius fifty-one, and Flamſtead only thirty-five. In Bootes, Ptolemy gives twenty-three, Tycho reduces them to eighteen, Hevelius makes them fifty-two, and Flamſtead fifty-four. In the Corona Borealis, or Northern Crown, Ptolemy lays down eight, Tycho eight, and Hevelius eight, Flamſtead makes them twenty-one. In Hercules, according to Ptolemy, they are twenty-nine, according to Tycho twenty-eight, according to Hevelius forty-five, and according to Flamſtead an hundred and thirteen. In Lyra, Ptolemy gives ſeven, Tycho eight, Hevelius eleven, and Flamſtead fourteen. In the Swan, Ptolemy gives nineteen, Tycho eighteen, Hevelius forty-ſeven, and Flamſtead eighty-one. In the Caſſiopeia, Ptolemy gives thirteen, Tycho twenty-ſix, Hevelius thirty-ſeven, and Flamſtead fifty-five. In Perſeus, Ptolemy gives twenty-nine, Tycho twenty-nine, Hevelius forty-ſix, and Flamſtead fifty-nine. In the Auriga, or Waggoner, Ptolemy gives fourteen, Tycho nine, Hevelius forty, and Flamſtead ſixty-ſix. In Serpentary, Ptolemy gives twenty-nine, Tycho fifteen, Hevelius forty, and Flamſtead ſeventy-four. In the Serpent, Ptolemy has given eighteen, Tycho thirteen, Hevelius twenty-two, and Flamſtead ſixty-four. In the Sagitta, the Arrow, Ptolemy has given five, Tycho and Hevelius have continued the ſame number, and Flamſtead has made them eighteen. In the Eagle, or Antinous, Ptolemy has given fifteen, Tycho twelve, Hevelius twenty-three, and Flamſtead twenty-one. In the Dolphin, Ptolemy has given ten, Tycho ten, Hevelius fourteen, and Flamſtead eighteen. In the Equuleus, or Horſe's Head, Ptolemy has given four, Tycho four, Hevelius ſix, and Flamſtead ten. In the Pegaſus, or Horſe, Ptolemy has given twenty, Tycho nineteen, Hevelius thirty-eight, and Flamſtead eighty-nine. In the Andromeda, Ptolemy has given twenty-three, Tycho twenty-three, Hevelius forty-ſeven, and Flamſtead ſixty-ſix. In the Triangle, Ptolemy has given four, Tycho four, Hevelius twelve, and Flamſtead ſixteen. In the Aries, or the Ram, Ptolemy has given eighteen, Tycho twenty-one, Hevelius twenty-ſeven, and Flamſtead ſixty-ſix. In Taurus, or the Bull, Ptolemy has given forty-four, Tycho forty-three, Hevelius fifty-one, and Flamſtead one hundred and forty-one. In Gemini, or the Twins, Ptolemy has given twenty-five, Tycho twenty-five, Hevelius thirty-eight, and Flamſtead eighty-five. In Cancer, or the Crab, Ptolemy has given twenty-three, Tycho fifteen, Hevelius twenty-nine, and Flamſtead eighty-three. In the Lion and Berenice's Hair, Ptolemy has given thirty-five, Tycho thirty and fourteen, Hevelius forty-nine and twenty-one, Flamſtead ninety-five and forty-three. In Virgo, Ptolemy gives thirty-two, Tycho thirty-three, Hevelius fifty, and Flamſtead an hundred and ten. In Libra, or the claws of the Scorpion, as it was called by the antients, Ptolemy gives ſeventeen, Tycho ten, Hevelius twenty, and Flamſtead fifty-one. In the Scorpion, Ptolemy gives twenty-four, Tycho only ten, Hevelius twenty, and Flamſtead forty-four. In Sagittary, Ptolemy gives

gives thirty-one, Tycho only fourteen, Hevelius twenty-two, and Flamstead sixty-nine. In Capricorn, Ptolemy gives twenty-eight, Tycho the same number, Hevelius twenty-nine, and Flamstead fifty-one. In Aquarius, Ptolemy gives forty-five, Tycho forty-one, Hevelius forty-seven, and Flamstead an hundred and eight. In Pisces, or the Fishes, Ptolemy gives thirty-eight, Tycho thirty-six, Hevelius thirty-nine, and Flamstead an hundred and thirteen. In the Whale, Ptolemy gives twenty-two, Tycho twenty-one, Hevelius forty-five, and Flamstead ninety-seven. In Orion, Ptolemy gives thirty-eight, Tycho forty-two, Hevelius sixty-two, and Flamstead seventy-eight. In the Eridanus, Ptolemy gives thirty-four, Tycho only ten, Hevelius twenty-seven, and Flamstead eighty-four. In the Hare, Ptolemy has given twelve, Tycho thirteen, Hevelius sixteen, and Flamstead nineteen. In the Canis Major, or Great Dog, Ptolemy gives twenty-nine, Tycho only thirteen, Hevelius twenty-one, and Flamstead thirty-one. In the Canis Minor, or Little Dog, Ptolemy only two, Tycho the same number, Hevelius thirteen, and Flamstead fourteen. In the Ship, or Argo, Ptolemy forty-five, Tycho only three, Hevelius four, and Flamstead sixty-four. In the Hydra, Ptolemy twenty-seven, Tycho nineteen, Hevelius thirty-one, and Flamstead sixty. In the Cup, or Crater, Ptolemy gives seven, Tycho only three, Hevelius ten, and Flamstead thirty-one. In the Crow, or Corvus, Ptolemy only seven, Tycho but four, Flamstead nine. In the Centaur, Ptolemy thirty-seven, Flamstead only thirty-five. In the Wolf, or Fera, Ptolemy nineteen, Flamstead twenty-four. In the Altar, Ara, Ptolemy seven, Flamstead nine. In the Southern Crown, or Corona Australis, Ptolemy thirteen, and Flamstead twelve. In the Piscis Australis, Ptolemy eighteen, Flamstead twenty-four.

This is the account of the several numbers with respect to the antient constellations. To these we are to add two other lists; the new southern constellations, and the constellations made by Hevelius out of the before unformed stars. The account of the new southern ones, according to Hevelius is this: the Noah's Dove has ten stars, the Royal Oak twelve, the Crane thirteen, the Phœnix thirteen, the Indian twelve, the Peacock fourteen, the Bird of Paradise eleven, the Bee four, the Chamelion ten, the Southern Triangle five, the Flying Fish eight, the Sword Fish six, the Amercian Toucan nine, and the Hydrus, or Water-Serpent, ten.

The stars of Hevelius's new constellations are, in the Lynx, according to Hevelius, nineteen, to Flamstead forty-four; in the Little Lion, according to Flamstead, fifty-three; Hevelius gives to the dogs Asterion and Chara twenty-three, Flamstead twenty-five; Hevelius to Cerberus four; Hevelius to the Fox and Goose twenty-seven, Flamstead thirty-five; Hevelius to Sobieski's Shield seven; to the Lizard ten, Flamstead sixteen; to the Camelopard, Hevelius gives thirty-two, Flamstead fifty-eight; to the Unicorn, Hevelius gives nineteen, Flamstead thirty-one; and to the Sextant, the former gives only eleven, and the latter forty-one. The Cor Caroli is a single star of the second magnitude near the Great Bear.

CONVERSE. A term used by mathematicians to express their making a second use of the same demonstration, and employing it to prove something more than what immediately relates to that which it was established to shew. In this case a second proposition is a consequence of the first, and proves its point upon the same principles. One proposition is said to be the converse of another, when after a

conclusion

conclusion is drawn from something, supposed in the converse proposition, that conclusion is first supposed; and then that which was before supposed, is drawn from it as a conclusion. It is not easy to define these things clearly to those who are unaccustomed to these studies, but an example will set it in a plain light.

If two parallel lines are crossed by a third, the alternate angles will be equal. In this proposition the supposition is, that the lines are parallel. The conclusion is, that the angles are equal. Now the converse of this proposition is, if the alternate angles are equal, then the lines are parallel. In this the supposition is, that the angles are equal, and the conclusion is, that the lines are parallel. These propositions are the converse of one another. This is a circumstance of more importance, than a young student might be aware of: for in geometry wherever the inseparable and incommunicable property is found, there is the thing itself; and every proposition about such properties implies the truth of its converse.

COPERNICAN SYSTEM. That system of the universe which Aristarchus, Philolaus, and the rest, had established in less happy times, Copernicus revived, and added to it so much that he deserved it should be called by his name. These philosophers asserted, that the sun stood still in the centre of the universe, and that its seeming motion was owing to that of the earth, but they were discountenanced, and their principles rejected. Instead of the system which might have been founded on these, and the grounds of which, even the early Aristarchus had laid, the doctrine of the earth's immobility was received; and Ptolemy, putting together the opinions of those who had endeavoured, at different times, to account for the appearances of the heavens on that plan, and adding to them a great deal from his own imagination, put together, and delivered to the world that system, which, though erroneous, must be allowed ingenious, and by the help of epicycles and excentrics, accounted in his way for the appearances and motions, direct, retrograde, and stationary, of the planets. These, according to him, were three inferior, or between the fixed earth and the circle of the sun, the moon, Mercury, and Venus; and three superior, or above the sun, Mars, Jupiter, and Saturn. Thus was the world contented for some ages.

Copernicus, setting out upon the plan of truth delivered by the old philosophers, substituted to the daily motion of the sun, planets, and fixed stars round about the earth, that of the earth itself. He placed the sun in the centre of the universe, immoveable and fixed, and he made the earth, as well as the rest of the planets, for he declared the earth no more than one of them, move round the sun. He was not content with giving one motion to the earth, he immediately allotted it three different movements. The first round its own axis, turning from west to east, in describing the equinoctial circle in the course of a day and a night: the second is the annual motion which it makes round the sun upon the eliptic: this is in the same direction with the first from west to east: and the third he called its motion of declination: this also is annual, and is made contrary to the succession of the signs; and this being combined with the second, is the cause why the axis of the earth is at all times directed to the same point in the heavens, and the appearance is the same as if the earth were utterly immoveable.

Copernicus having fixed in this manner the sun in the centre of the universe, disposes the planets round about it in the following manner. He begins with the most remote; and having given Saturn the circle or sphere for his revo-

 lution

lution about the diſtant ſun, he next aſſigns the place of Jupiter, then Mars has his ſtation, and before he deſcends to Venus he leaves a ſpace, in which he forms a circle for the courſe of our earth, attended by the moon, which is properly its ſatellite. Below this, or nearer to the ſun, he placed in their ſtations Venus and Mercury. On the circumference of the excentric of each planet he placed the centre of an epicycle, to which he attributed a ſynadic motion, during the time in which the planet was running the circle of the epicycle by a periodical motion. This epicycle had for its diameter that which Ptolemy had attributed to the circles of the planets.

Thus far Copernicus adapting an early opinion, and adding to it, with great ingenuity, but we are not to ſuppoſe, that Copernicus finiſhed what he began, or perfected that ſyſtem which is the truth itſelf, and which in honour to his early ſervices in it we continue to call by his name. Kepler laboured on this ſyſtem, and he reduced it to a much greater ſimplicity. He ſubſtituted to the excentrics and epicycles, which Copernicus had attributed to the planets, ellipſis's, which very nearly repreſented the ſame appearances. He ſuppoſed, with Copernicus, the ſun fixed in the centre of the univerſe, for on that principle all truth in aſtronomy depends, and he placed round that body firſt Mercury, then Venus, then the earth, with her moon, about her, and finally Mars, Jupiter, and Saturn: thus far they went together.

In order to repreſent the different heights of the ſun above the horizon on different days of the year, which Copernicus had explained by a motion of declination in the earth, Kepler propoſed the earth's motion, as being formed in the ecliptic, in ſuch a manner, that the axis of its equator was, during the courſe of the year, directed to one and the ſame point in the heavens, which forms all the ſame appearances. And finally to take away from the fixed ſtars all kinds of motion, not excepting even that by which they ſeem to revolve about the poles of the ecliptic in the allotted ſpace of five and twenty thouſand years, which was a received opinion, he attributes to the axis of the earth, which paſſes through the poles of the equator, a motion, though a very ſlow one, round the poles of the ecliptic from eaſt to weſt. This motion he propoſed to be performed by the axis of the earth, in the ſame number of years as Copernicus had taken for the revolution of the fixed ſtars about the poles of the ecliptic.

Thus was the ſyſtem of Copernicus improved, and rendered much more ſimple by Kepler, but ſtill retained its name of the Copernican. This ſyſtem, thus improved by Kepler, repreſents perfectly well all the appearances in the univerſe, provided we ſuppoſe the fixed ſtars to be placed at a diſtance from the earth, which is extremely great in compariſon of the ſun's diſtance. For ſuppoſing the earth in its annual orbit, and a fixed ſtar placed at ſuch a diſtance as ſhould be determined proper, the earth running in its proper motion over its annual orbit in the appointed ſpace of a year, will be, at the end of ſix months, in a place very diſtant from that in which it was before; and this diſtance, being no leſs than the whole diameter of its annual orbit, a Perſon ſituated on the earth, will ſee the ſame fixed ſtars, inclined to its firſt direction, in a quantity meaſured by the angle, which is called its parallax: and this ſtar will ſeem to anſwer to ſeveral different parts of the heavens, which will be leſs and leſs diſtant from one another, in proportion as that ſtar is more and more diſtant from the ſun.

To anſwer to the preſent appearances, it is therefore neceſſary to place the fixed ſtars at an

an immenſe diſtance from the ſun, in order to make that parallax, or that angle, almoſt inſenſible, and to our perceiving little or no parallax from the annual motion of the earth, according to the Copernican ſyſtem. The fixed ſtars are at this immenſe diſtance, and thus what is taught as a proof of one thing, often convey knowledge alſo in another. Tycho Brahe could not perſuade himſelf, that the fixed ſtars were at that diſtance from the ſun which the ſyſtem of Copernicus eſtabliſhed, he therefore adapted part, and diſcarded part. His ſyſtem is part Copernican, and part Ptolemaic. *It will be ſeen under the article* TYCHONIAN SYSTEM.

COR LEONIS. A name given to a large and bright ſtar in the breaſt of the Lion, they called it alſo Baſilius: this is a very uſeful method with regard to conſpicuous ſtars.

CORONA BOREALIS, *the Northern Crown.* One of the conſtellations of the northern hemiſphere; it is but a ſmall one, but it is one of the old forty-eight mentioned by all the Greek writers, and in general borrowed by that people from the Egyptians. As the Crown is not of any great extent, it does not comprehend a great quantity of ſtars. It is drawn in figure of a ſingle circle, or rim of a flat form, from which there riſe ten pyramids of equal bigneſs. The conſtellations placed about the Northern Crown are Bootes, Hercules, and the Serpent. It occupies indeed a ſmall ſpace left between theſe three figures.

CORONA AUSTRALIS, *the Southern Crown.* One of the conſtellations of the ſouthern hemiſphere, diſtinguiſhed by this addition from one of the ſame name in the northern. It is a figure of no great conſideration in the hemiſphere, it is but of ſmall extent, and it contains only a few ſtars. Theſe however are ſo diſpoſed that the conſtellation is ſufficiently marked by them, and eaſily diſtinguiſhed. It is repreſented in form of a crown, conſiſting of a broad rim, and ten rays riſing from it. Theſe are of the ſame form with thoſe of the Northern Crown, but they are greatly ſhorter.

The conſtellations, between and among which the Southern Crown is ſituated, are Sagittary, the Indian, the Peacock, and the Altar. It is placed directly between the two fore feet of the figure Sagittary, which is in a poſture of walking. The Indian's arrow is almoſt parallel in direction to it. The tail of the Peacock is oppoſite to its rays, and the foot of the Altar to the circle on which thoſe rays are placed.

The antients counted thirteen ſtars in the Southern Crown, but the writers of later time do not allow ſo many. Ptolemy took this number, which he gives it, from Hipparchus, but even Flamſtead ſets down no more than twelve, and not one of theſe is of any conſiable magnitude. They are principally ſituated along the line of the rays, but they are all ſo near to the conſtellation Sagittary, that it is a wonder they were ever formed into one by themſelves. The Greeks indeed ſeem to have underſtood it as a part of that conſtellation, and not without reaſon. Thoſe who deviſed the figure of Sagittary, though we know not why, probably made and intended it as a part. The Greeks, who are never at a loſs for a fable on theſe occaſions, tell us, that this Sagittary was one Crotus, a ſon of Eupheme, one of the nurſes of the muſes, and they ſay, that the whole figure of Sagittary, which approaches very much to that of the Centaur kind, only that the hoofs are cloven, was emblematical, and intended to expreſs the ſeveral

ral qualities of this ſportſman and poet, whom the Gods had at length taken from Helicon, where he lived among the muſes, and placed among the ſtars. They ſay the crown at his feet ſerved to expreſs his contempt of worldly grandeur.

CORRESPONDING PARALLELS. A term uſed by aſtronomers to expreſs certain circles in the concave ſphere of the heavens, and certain others on the convex ſurface of the earth, which have this mutual relation to one another.

The circles called parallels, in the deſcription whether of the earth or heavens, are thoſe which are drawn either way between the equator and one of the poles, and are at equal diſtance, in all their parts, from the pole and equator. There may be as many of theſe conceived as the perſon pleaſes, and they ſerve on the earth to mark out the diſtances of latitudes, as the meridians do to meaſure the diſtances of places in longitude, the one being meaſured upon the meridian, and the other upon the equator.

As all the circles of the earth have circles anſwering to them in the heavens; theſe parallels have ſuch as anſwer to them there, and theſe with thoſe diſtinct parallels, to which they ſo anſwer upon the ſurface of the earth, are what aſtronomers underſtand by the term correſponding parallels.

The circles in the heavens, which anſwer to certain circles upon the earth, are formed by ſuppoſing the plane of the circle on the globe of the earth to be continued up to the heavens; juſt as the poles of the heavens are formed by ſuppoſing the poles of the earth, or the ends of the earth's axis each way extended, ſtrait to the heavens. Thus as we may conceive any number of parallels between the equator of the earth, and either pole of the earth, ſo we, in the heavens, conceive an equal number of parallels between the pole and the equator, which are ſmalleſt as neareſt to the pole, and all the way become larger towards the equator, theſe parallels being formed, like the other circles of the heavens, by producing or continuing the planes of the circles on the earth up to the heavens. Each of them may be conſidered as ariſing from ſome parallel on the earth, and then the parallel on the earth from which it ſo ariſes, and the circle, or parallel itſelf, in the heavens, are called correſponding parallels. Thus every parallel on the earth that we conceive, on which ſide ſoever of the equator, may be conceived to have a correſponding parallel on the ſame ſide of the equator of the heavens, this being a circle in the ſphere of the heavens formed by continuing thither the plane of the parallel upon the earth: and, on the ſame principle, if the parallel in the heavens be firſt formed, we may conceive a correſpondent parallel to be formed for it on the earth, by continuing, or bringing down, the plane of the celeſtial circle to the ſurface of the globe, where it will fall upon it.

The correſponding parallels, therefore, are thoſe which in the heavens are at the ſame number of degrees, minutes, and ſeconds, diſtance from the celeſtial equator, that the parallels, correſponding to them upon earth, are from the equator of the earth, be it on the north or ſouth ſide in the heavens, and on the earth, that they are drawn. Some aſtronomers, fond of multiplying terms without occaſion, have called thoſe parallels on the heavens, which have the ſame diſtance on one ſide of the equator, and thoſe on the earth which have the ſame diſtance on the other ſide of the equator, oppoſite parallels.

CORVUS,

CORVUS, *the Raven, or, as some call it, the Crow.* One of the forty-eight constellations of the antients, of which we read in Ptolemy, and in all the writers who have followed him. It is a sign that makes no great figure in the heavens; it is small, and contains only a few stars. The figure is better drawn than in many other of the constellations. We have bears with tails, and snakes with hair upon their heads in the skies, though there are none such upon the earth; but the raven is a raven, and the figure is a very good one. It is situated upon the back of the Hydra, the posture of which creature shews, that it is designed as in motion, consequently the Raven's situation is not a very safe one, it stands accordingly in a tottering manner, and has its head bent down, and its wing in part raised as ready to balance it.

The constellations, between and among which Corvus is placed, are the Centaur, Virgo, and the Cup. I have already mentioned that it stands upon the back of the Hydra; its situation is near the tail of that constellation. The Centaur is under it, and at some distance behind; the hand of Virgo, in which is the spike, or ear of corn, is over its wings and tail; and the Cup, which is also fixed upon the back of the Hydra, is at a small distance before it.

The antients counted seven stars in the constellation Corvus, and so many are readily visible in it. Ptolemy has set down this number; and the latest observations, those of Flamstead, have added only two to it, they make it nine. Of these there is not one of the first or second magnitude, but there are no less than three of the third, and these, as there are no others very near, make a conspicuous appearance. One of these is in the right, another in the left wing, and the third in the foot, and consequently in the body of the Hydra, for the foot stands upon it. There is also a conspicuous star in the beak, another in the neck, and another in the breast. The last of the seven old ones is behind that in the right wing of the bird.

That the constellation Hydra, with the Raven and the Cup upon it, were all of Egyptian origin, appears very probable. The Greeks, however, who will have all the constellations to refer to some part of their history or fable, that they may seem the produce of those of their own country, say, that this Raven was once a beautiful virgin Coronis, the daughter of Phlegeos, and mother of Esculapius by Apollo; they say, that the nymph afterwards played the deity false, and had an intrigue with Ischys the son of Elatus. The sun saw nothing of this, though Homer says, that he sees every thing; but the Raven was perched upon the tree, under whose shade it was transacted; the bird told Apollo of the violation, and they say, till that time it had been white, but that the god turned him, and all his generation, black, for the message, and made him the prophet of ill-news of all kinds after. Ischys, they say, he transfixed with his arrows; but in the end, thinking he had some obligation to the Raven, he took it up into the skies.

CORYNETES. A name by which some have called the constellation Hercules, or Engonasin. It is one of the old Greek names, and expresses only a man with a club.

CORYNEPHEROS. A name by which some have called the constellation Hercules, or the Engonasin of the old Greeks. This also is one of its Greek names; and expresses a man with a club. The Greeks, it is evident, when they had received this constellation from the Egyptians, did not know what to

make

make of it, it is evident that they received it in the figure of a man kneeling and having a club in his hand; and they named it from the one or from the other of theſe circumſtances. From the latter it obtained this name Corynepheros, and the other Corynetes, and from the other thoſe of Oclanos and Engonaſin. It was long after, that, in the ſcheme of adapting their fables to the figures in the heavens, they called this Hercules.

CRAB. One of the northern conſtellations, or of thoſe of the northern hemiſphere. It is alſo one of the twelve ſigns of the zodiac, or a mark of a diviſion of the ecliptic. *See* CANCER.

CRABRO INDICUS, *the Indian Hornet*. A name given by ſome, who will have uncommon names for every thing, to the conſtellation Apis, the Bee, or, as others call it, the Fly, Muſca, one of the new ones of the ſouthern hemiſphere.

CRANE. One of the new conſtellations of the ſouthern hemiſphere. *See* GRUS.

CRATER, *the Cup*. One of the forty-eight old conſtellations mentioned by the Greek aſtronomers, and from them by thoſe of all other nations.

The Cup is but a ſmall conſtellation, and it is not conſiderable either for the quantity or magnitude of its ſtars. Its figure is regular enough, and it is decently drawn, we ſee it in the ſchemes of the heavens as a cup with its baſe, its rim, and a pair of handles, from the top of each of which there riſes the body and head of a ſerpent, as is common in pieces of carved plate.

The conſtellations, among which the Cup is placed, are Corvus, Virgo, Leo, the Sextant, and Hydra. It is fixed upon the back of the Hydra at a ſmall diſtance before the Raven, whoſe head is towards it, and the top of its wings, very near to one of the handles, Virgo and Leo are over it The left wing of the former, and the hinder feet of the latter ſign, come over its two handles, and the limb of the Sextant is at a ſomewhat greater diſtance before them; the Raven is behind it.

The old aſtronomers counted ſeven ſtars in the conſtellation Crater. Ptolemy ſets down ſo many, Tycho Brahe mentions only three, but Hevelius has brought it higher than the old number, he makes it ten, and Flamſtead raiſes it to three times that number, and ſomething over, he makes them thirty-one; of theſe there is not one either of the firſt or ſecond magnitude. There is only one of the third, and even this has its title to that rank diſputed, many allowing it to be only a fourth. This is in the foot or baſe of the cup, toward its edge. The other ſtars in this conſtellation are, for the moſt part, of the fourth magnitude; and this in the foot being larger than all theſe, there is no room to diſpute its title to a higher claſs. There are ſeven allowed ſtars of the fourth magnitude, and theſe take up the greateſt number among thoſe which are eaſily ſeen, the reſt are principally of the ſmalleſt kinds, and no one can wonder that they were overlooked by the antients. There are three pretty conſpicuous ones on the body of the Cup, as many in the rim, and one in the Serpent that riſes from each handle, one of theſe is in the head of that ornament, and the other in the lower part of its neck. There is alſo a conſpicuous ſtar in the hollow or mouth of the Cup, and one very near the foot, in the body of Hydra, oppoſite pretty nearly to the largeſt of the ſtars in Crater, which is on the other ſide of the foot.

The Greeks, as will be hereafter obſerved under the article Hydra, were very much at a

loſs

loſs to know what part of their hiſtory, or of their fable, to adapt to theſe three contiguous conſtellations. One account of the Cup will be found there, but that is wilder than any thing that can be conceived; the more modeſt among them give it another origin. They tell us, that, in Cherſoneſus, in the neighbourhood of the antient Troy, where Proteſilaus had a monument, there was a city called Phlaguta, where one, whom they call Demiphon, reigned. In theſe territories, there was a ſudden and terrible deſtruction of the people by ſickneſs. Demiphon conſulted the oracle of Apollo how he ſhould obtain relief, and the ſevere decree was, that one of the nobleſt families in the place muſt annually give a virgin daughter to be ſacrificed to the houſhold-gods. Demiphon, they tell us, had the order obeyed, and excepted only his own family, the reſt had the chance every year of eſcaping, and only the chance, for it was decided by lot. Mathuſius, at length, declared his unwillingneſs that his daughter ſhould ſtand a hazard from which thoſe of the royal family were excluded; he was a man of power, and he declined giving in his daughter's name unleſs thoſe of the king's daughters ſhould alſo be given. Demiphon, enraged at the inſult, took the only child of Mathuſius without the chance. Every body was glad to have eſcaped, and only Mathuſius was left to complain. He did it in ſecret, and he meditated that revenge in ſecret, which he could not take openly. He pretended to be reſigned, he ſaid it was but his fortune, and that what had happened now might have been done the next year by lot. Demiphon and he were reconciled, and the diſpute forgotten. When all was at peace between them, he pretended a public ſacrifice, and invited the unſuſpecting monarch and his family. Demiphon had publick buſineſs, but he ſent his daughters early, himſelf followed. Mathuſius killed them all, and, by way of welcome, when the father came, gave him a cup in which their blood was mixed with wine. When the murder was diſcovered, Mathuſius and the horrible cup were thrown together into the ſea, and the ſea was called by his name, and the port by that of the veſſel, Mare Mathuſium and Crater. The god, who had been the original occaſion of the ſacrifice, they ſay, placed the Cup afterwards in the heavens as a ſign of cruelty.

The reformers (as they call themſelves) of the ſphere, being determined to make every one of the conſtellations allude to ſome ſcripture ſtory, have pitched upon two or three for this. Schickard calls it the Cup of Joſeph, and Hartſdorf the Cup of Saul; but Schiller, who is at the head of this folly, makes it the ark of the covenant; to this purpoſe he takes into it the ſtars of Corvus.

CRESCENT. The figure of what we call the new moon, an edge of light, of greater or leſſer breadth, ſurrounding part of the circumference of a globe of opake matter. It is not only the moon that we ſee put on this form, the two inferior planets, Venus and Mercury, alſo aſſume it, and in the former, it is a moſt pleaſing ſpectacle through the teleſcope.

Theſe planets, like the others, and like to our moon, receive their light wholly from the ſun, and conſequently one complete hemiſphere of them is always enlightened. The half of their ſurface, which is toward the ſun, is light, and the other half dark; but as theſe two planets are not beyond the earth, but between us and the ſun, we do not ſee the whole enlightened hemiſphere, but only a larger or a leſſer part of it: they encreaſe from an abſolute ſtate of darkneſs to all the degrees of illumination, which we ſee in the moon, and by degrees decreaſe again. When Venus ap-

pears

C R

pears with all that ſurpriſing luſtre, and when ſhe appears largeſt in the heavens, ſhe is no more than a creſcent. When ſhe appears ſmaller, ſhe is fuller of light, but then ſhe is more remote from the earth.

No planet ſhews more of this change than Mars, although he being above the earth, and not between that and the ſun, never becomes the creſcent or half moon, but only changes in the different parts of his orbit from oval, or, in part impaired, to round; yet, at ſome times, that is when moſt diſtant from the earth, he appears faint and little, and is as little obſervable as any ſtar in the heavens; and, at other times, when nearer to the earth, he appears ſo much larger and brighter, and with a light ſo much purer, that he may be taken for another ſtar.

Additionally to theſe changes, Venus has her altered figure from the thin creſcent to the fully illuminated globe. Mercury has the ſame, but we have few opportunities of ſeeing him, and of thoſe few only a part, nay, and that but a ſmall part, are favourable. Venus, on the other hand, is very perfectly to be ſeen, but not moſt ſo when ſhe appears bright. The utmoſt diſtance at which Venus is ever ſeen from the ſun, is forty-ſeven degrees and an half, that is about the diſtance of the moon on the fourth day after her conjunction. Sometimes ſhe only gets to forty-five degrees and an half.

When this planet paſſes out of the ſun's rays on the eaſt, ſhe appears above the horizon after ſun-ſet, and, by the teleſcope, we diſcover her to be ſmall and nearly round, that is, ſhe is beyond the ſun, and we ſee her whole enlightened hemiſphere, or nearly ſo, but ſhe is very diſtant from us. As ſhe gets more and more diſtant from the ſun, ſhe increaſes in brightneſs and apparent magnitude; one would ſuppoſe ſhe had been in the firſt ſtate, or creſcent, and was all this time filling with light, but it is otherwiſe, ſhe is all this time in the decreaſe, and the teleſcope preſents her as the moon in that period, abating more and more from her roundneſs. When ſhe is in her greateſt digreſſion, we ſee her like the moon at her firſt quarter, for ſhe preſents to the earth at that time only half her enlightened hemiſphere; from this time approaching, in appearance, towards the ſun, ſhe becomes concave, and forms a creſcent ſmaller and ſmaller in its breadth, till ſhe is immerſed again in his rays, and we have her whole dark hemiſphere towards us.

When this planet comes out of the ſun's rays on the weſt, we ſee her in a morning before ſun-riſe, and ſhe is then a beautiful creſcent, continuing ſo till the time of her greateſt digreſſion, when ſhe again appears cut in half, and from this time ſhe becomes fuller of light, but decreaſes in apparent magnitude till ſhe is again hidden in the ſun's rays. When this planet is neareſt to the earth, ſhe makes the moſt beautiful appearance to the teleſcope, her ſurface appearing ſpotted like the moon's, and her figure a beautiful creſcent; but to ſee her moſt diſtinctly, ſhe muſt be viewed when at a moderate diſtance, for at thoſe other times ſhe is ſo little elevated above the horizon, that the vapours of the earth ſpoil the accuracy of the view.

CRIUS. A name by which ſome call the conſtellation Aries, the Ram. Κριος is its Greek name.

CRONOS. A name given by ſome of the old aſtronomical writers to Saturn.

CROSS, *or* Cross of Christ. A name by which ſome have called one of the northern conſtellations. It is the Swan they have dignified

nified with this name, altering the figure, and difpofing the ftars accordingly. Schickard makes it the crofs only; but Schiller adds to it the figure of St. Helena, the finder of the crofs, and calls it the crofs and St. Helena. *See* CYGNUS.

CROSS, *or* CHRIST'S CROSS. According to Schiller, alfo one of the conftellations of the fouthern hemifphere; it anfwers to the fouthern triangle, being formed of the ftars, which, according to other aftronomers, form that conftellation. Schiller was the inventor of this idle emendation. After he had raifed up the apoftles, faints, and martyrs to the fkies, it would have been very hard to have retained no marks of the Saviour of the world there. He accordingly turned the triangle into a crofs, as the others of the fame perfuafion had made the northern conftellation of the fame name an emblem of the Bleffed Trinity.

CROTUS. A name by which fome of the old aftronomers have called the conftellation Sagittary. The Greeks were divided in their opinions what to make of this figure, it could not be a Centaur, though very like one, becaufe they never defcribe the Centaurs with bows and arrows. They folved the difficulty by drawing up the ftory of this Crotus; they fay he was a companion of the mufes, and a notable huntfman, and that Jupiter placed him at their requeft among the ftars.

CROW. One of the old forty-eight conftellations, of which we read in Ptolemy, and in all the writers who have followed him; it is more properly called the Raven. *See* CORVUS.

CROWN OF THORNS. A name which Schiller has given to the Corona Borealis, one of the conftellations of the northern hemifphere. He will have every conftellation reprefent fome part of the fcripture-hiftory; and this he makes the Crown of Thorns worn by our Saviour.

CROWN SOUTHERN. One of the conftellations of the fouthern hemifphere, diftinguifhed by that epithet from one of the fame name in the northen; this is placed at the feet of Sagittary. *For an account of the ftars which it contains, fee* CORONA AUSTRALIS.

CUBE. A name of one of the regularly figured folids. A die is a cube. The term expreffes a folid, terminated by fix fides, every one of which is an exact fquare. A cube may be thus formed. Suppofe a fquare to be carried parallel to itfelf, the length of one of its fides, it will thus have defcribed a cube. The fide of the fquare by this motion, of which the cube is generated, is called the root of the cube, and this exactly anfwers to the fingle power, the fquare and the cube root in arithemtical calculations and in numbers. The quantity of a cube is denominated by the fide of one of its fquares. If every fide of a cube is of a foot fquare, the whole is called a cubic foot, and the meafure of any cube is expreffed by faying how many cubic inches, or the like, it may be divided into. Now in order to difcover how many cubic inches, or the like, there may be in a cube of a given meafure, the method is to find how many inches fquare there are in one of the fides, and when this is found, that number being multiplied by the fquare root, the product is the number of inches in the cube: a fquare number multiplied by its fquare root produces what is called a cube in numbers. This term is ufed to exprefs it, becaufe if we repre-

reprefent every unite in the number by a little cube, the whole produce will be a larger cube, compofed of all the little ones. We meafure all furfaces by fquares, and in the fame manner we meafure all folids by cubes: the cube being to the folid, what the fquare is to the furface. The dimenfions of thefe are expreffed by faying how many cubic feet, inches, &c. they contain. Thus we fay, how many cubic feet of earth there are in an hill, or the like.

CUBITUS NILI. A name given by fome to the ftars which form the fign Leo in the zodiac. It is a tranflation of the Coptic name Pimentekeon.

CUI. A name by which the planet Jupiter is called among the eaftern aftronomers. The proper fignification of the word is a year, but why it is made a name for this planet is not eafy to fay.

CUP. One of the antient forty-eight conftellations continued down through all times. It is fituated upon the back of the conftellation Hydra, and contains only a few, and thofe not very confiderable ftars. Some pretend that this conftellation was placed in the heavens in commemoration of the cup of Icarius, in which he firft taught men the ufe of wine. Others fay, it was the famous cup in which Mathufius gave Demiphon the blood of his daughters; this laft is the more general ftory, but the Greeks were not the inventors of the conftellations, nor knew with what defign they were invented. *For the ftars comprized in this conftellation, fee the article* CRATER.

CUPID AND VENUS. A name by which fome of the old aftronomers have called the conftellation Pifces. They have fuppofed Venus and her fon, in terror of the giant Typhon, to have thrown themfelves into the Euphrates, and there to have taken up this fhape till the danger was over.

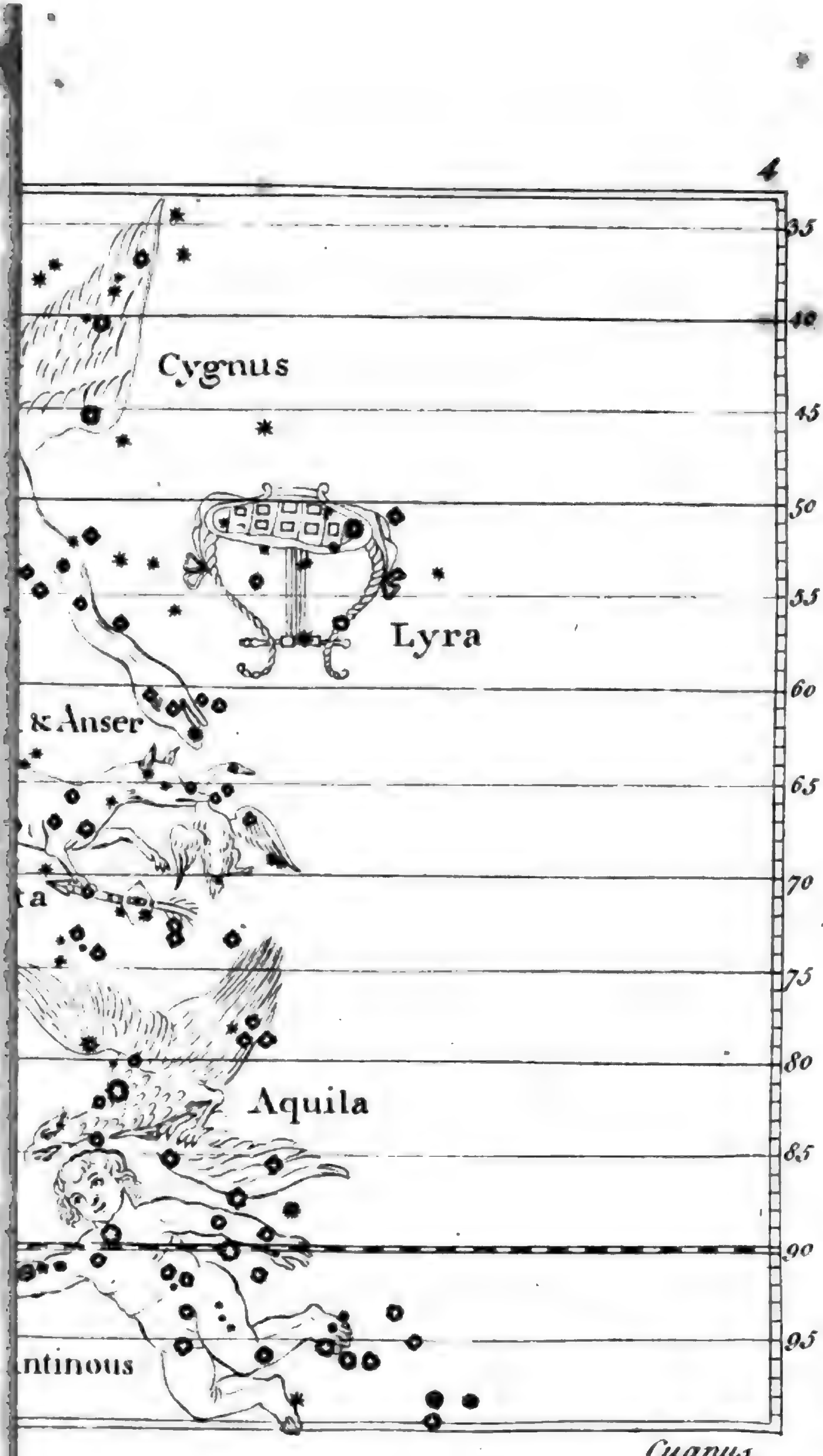
CURRUS. A name by which fome have called the conftellation Delphinus, the Dolphin. It is an old name, and was received among the Latin writers; we find Cicero ufing it.

CURVILINEAR ANGLE. Expreffes an angle formed by the opening of two curves, or curve lines, which touch one another in a point. *See this farther explained under the term* ANGLE.

CUSPIS. A name by which fome of the old writers have expreffed the large ftar that is at the point of the arrow in the conftellation Sagittary. It is borrowed from the Arabians. It was a cuftom with them to name the confpicuous ftars in every conftellation, befide giving the general name to the affemblage. They call this ftar Zugi Al Nufhaba, which fignifies the point of an arrow. The whole conftellation they call Al Kaus.

CYCLE *of the Moon*. A cycle of nineteen years, calculated by the Greek Meto, and from his name more ufually called the Metonic cycle.

CYGNUS, *the Swan*. A conftellation of the northern hemifphere, mentioned by all who have written on aftronomy, but by fome of them called only Avis the Bird, and by others Gallina the Hen. It is one of the antient forty-eight conftellations, and feems to have been brought from Egypt into Greece by Thales, or fome others not long after his time, though the Greeks have attempted in this, as


4
Cygnus
Lyra
& Anser
a
Aquila
ntinous
35
40
45
50
55
60
65
70
75
80
85
90
95

Cygnus

in respect to the others, to adapt their own history and fables to them, that they might appear of the origin of that country.

The Swan is a moderately large constellation, and is pretty thick set with stars, though there are so many unformed ones about it, particularly toward the lower part of the neck, that we, who cannot determine with what intent the Egyptians, if it be their invention, gave this figure, are ready to wish that some other had been taken which might have comprized those also.

The figure is that of a swan flying, the tail spread in some degree, the wings extended, and the feet drawn up under the body: the neck is not protended forward in a strait line, but has two or three undulations.

It is situated between Hercules and Pegasus, in a space which it very happily fills. The other constellations about it are the Lyre, the Fox and Goose, the Lizard, Cepheus, and Draco. Hercules's left hand is protended toward it, but the Lyre is between: the head of the Fox with the Goose in his mouth, are very near that of the Swan. The fore feet of Pegasus come near the tip of the left wing, for the Swan is represented with the belly towards us, the Lizard is beyond the legs of the Horse toward the tail of Cygnus. The head of Cepheus also is near the tail, as is also the upper convolution of the body of the Dragon. The figure of the Swan is better drawn than those of many of the constellations. The Lizard, which is near its tail, is figured a great deal more like a greyhound.

The old catalogues of the fixed stars allowed nineteen to the constellation Cygnus. Hipparchus set down so many in his catalogue, and Ptolemy has followed him. Tycho reduced the number to eighteen, but Hevelius raised it to no less than forty-seven, and the accurate Flamstead makes them no fewer than eighty-three. Among these there are none of the first, nor even the second magnitude, some few are of the third, but the greatest part of them are of the smallest sizes. They are disposed very irregularly over the figure, there is one in the bill very bright and conspicuous, there are a few in the head, and though a great many lie unformed about the neck, there are but few within the out-line of that part of the figure, two of the largest in the constellation are on the body, one toward the breast, and the other nearer the tail, the rest are scattered over the wings and tail, more plentifully than on the body, and there is a conspicuous star on each foot, beside several on the legs, one of which, towards the knee of the right leg, is a very bright one.

The Greeks probably received this figure of a Swan among the other forms of constellations from their Egyptian instructors, but willing to make it pass for their own, they adapted something from their own history to it, that it might seem devised among them, and not put succeeding ages in mind to look farther than among themselves for the origin of the arts. They tell us, that this was the Swan in the form of which Jupiter debauched Leda, and became the father of Helen. They say, that when the borrowed form of the bird had done its purpose, the grateful deity, who had animated it for the time, carried it up into heaven, and here fixed it for ever among the stars.

This is the general story of the Swan, the parent of Helen; but the oldest writers among these people tell it otherwise. They say, that it was Nemesis, with whom Jupiter was in love, and that having attempted her chastity in vain, he at length thought of this stratagem; he transformed himself into a swan, and he commanded Venus, who was always his good friend

friend on these occasions, to pursue him thro' the skies in the form of an Eagle. Nemesis saw the chace, and the poor Swan threw itself to earth, and flew into her bosom for protection. The nymph received, and fondled the bird, she kept him in her arms till she dropped into a sleep, and Jupiter, who being a deity of intrigue, took all advantages, ravished her in this condition. This done, he took his flight; and to commemorate the adventure, when he and Venus had assumed their own forms again, he placed both the Swan and the Eagle in the starry heavens. This makes some difficulty about the mother of Leda; for all agree, that she was hatched out of the egg, which was the consequence of the embrace; but this may be reconciled. Some have gone a very round-about way toward it, and supposed, that Mercury, when Nemesis had laid the egg, carried it to Sparta, and dropped it into the bosom of Leda, and that Helen was afterwards produced out of it; but others find out that Nemesis and Leda were the same person.

Schickard, Schiller, and their followers, that they may make this, as well as the other constellations, preserve some part of the scripture history, call this the Cross, or the Cross of Christ, and St. Helena the hinder part of it. But these have few followers. It is obvious to all men what confusion must attend altering the figures of the constellations.

CYLINDER. One of the regular solids. It is an oblong figure rounded in the circumference, and every where of equal diameter. An even tube of glass, or other material, is a cylinder. If a strait line, which is either perpendicular, or inclined to the plane of a circle, be carried round the circle, all the while continuing parallel to itself in its first situation, and touching, with one end, the circumference of the circle. This line, thus moved, will describe a cylindrical surface; the original circle is the base of the cylinder, and the opposite end of the line will, in its motion, describe another circle exactly parallel to this, and equal to it in diameter. When the figure is formed, this also may be called a base of it, as well as the other: and the solid, contained between the cylindrical surface and the planes of these two circles, is a cylinder. A strait line, drawn from the centre of one of these bases to the centre of the other, is the axis of the cylinder, and the describing line, in any part, is called a side of the cylinder. So also is called any strait line that is carried from any part of the circumference of one of the circles directly to the other. A cylinder is expressed by the term *right*, if the axis be perpendicular to the base: but if it be inclined to the base, it is then an oblique, or a scalenous cylinder. If a plane, to which the axis of the cylinder is perpendicular, cut through every side of the cylinder, the section is a circle, and if the axis be inclined to the plane that cuts through them, the section is an ellipsis. The less the angle in this case, the more oblong becomes the ellipsis. It is thus also in conic sections.

CYNOSURA. A name given by many of the old writers to the constellation which is otherwise called Ursa Minor, or the Lesser Bear. The Greeks pretended that a nymph of this name, who had been one of the nurses of the infant Jupiter, was carried up into the skies.

D.

DÆMON. A name by which ſome, who love obſcure words, call the conſtellation Sagitta, the Arrow. They have this from Kircher, he ſays the Hebrews call it ſo.

DAGON. A name by which ſome have called the conſtellation Cetus the Whale, from a ſuppoſition that it was placed in the heavens in commemoration of the idol of that name. It is certain that the Whale, as it is called, has nothing of the figure of a whale about it. It has the head of a quadrupede, and the paws of one. Dagon was a Syrian idol, and had an human head and hands with a fiſh's tail, and the Jews called him Odir Dag, the Great Fiſh.

DAGAIM. A name by which ſome, who are fond of uncommon words, call the conſtellation the Dolphin. It is the Hebrew name of that ſign, and ſignifies only a ſea fiſh.

DAI USAR. A name by which ſome, who are fond of uncommon terms, have called the ſun. It is one of the Arabic names of that luminary. It expreſſes ſeer of all things.

DART. A name of one of the conſtellations of the northern hemiſphere, commonly called the Arrow, and by the Latins Sagitta. It is ſuppoſed to be that with which Hercules ſhot the Vulture which preyed upon Prometheus's liver. *See an account of its compoſition under the article* SAGITTA.

DAL AL CURSA. A name by which ſome, who are fond of hard words, call the conſtellation Caſſiopeia. It is the Arabic name, and it ſignifies inthroned, or ſeated on a throne, and is only a tranſlation of the old Greek name.

DANAB ALKETUS. A name by which ſome, who love hard words, have called the bright ſtar in the tail of the conſtellation Cetus. It is an Arabic term, and ſignifies, in that language, the tail of the Whale. They frequently thus named ſingle ſtars.

DAVID. According to certain writers, and their ſyſtems, a name of one of the conſtellations of the northern hemiſphere. It means the ſame with Perſeus. Schiller, Schickard, Hartſdorf, and ſome others, took it into their heads to reform the ſphere, and this they were to do by throwing out all the alluſions that were found in it to Pagan ſuperſtition, or but to Pagan hiſtory or fable. The two laſt only attempted this by adapting new names, or giving new ſtories of the figures as they found them, and they were therefore much more pardonable than the other, for he would be contented with nothing leſs than altering the figures, which would have been an occaſion of endleſs confuſion. Thus Schic-

kard left the Lion in the zodiac, and only instead of the Nemæan savage of the Greeks, desired it might be called the Lion of the tribe of Judah; but Schiller took the figure quite out of the zodiac, and put up that of St. Thomas in its place. It is to these writers that we owe all these new names, but they do not agree in them. Schiller calls this old constellation of Perseus St. Paul; but Schickard, that he may have something applicable to the Gorgon's head in the hands of Perseus, makes it David, with that of Goliah.

According to these enthusiastic reformers of the sphere, David is the name of another of the constellations. Schiller, resolved that every part of the heavens shall preserve, or shall refer to some scripture-story, has formed the stars of the Canis Major, or Great Dog, into this constellation. Schickard is much more moderate, he preserves the Dog, and only desires that, in order to keep up a good understanding with the bible, it may be called Tobit's Dog.

DAVID's CROWN. A name given by Hartsdorf to the Corona Australis, or constellation called the Crown in the southern hemisphere. Schiller makes it Solomon's Crown.

DAVID's HARP. A name given by Schickard, and some other enthusiastic writers, to the constellation Lyra. There are a set of these who will make every constellation allude to some scripture-story. This is very pardonable, while they do not alter the figure, but only give it a new name, as Schickard has done with respect to this: but Schiller has gone too far, he alters the form as well as the name, and, in place of the Harp, puts the Manger in which our Saviour was laid; arranging the stars under a new form. This makes confusion.

DAULO. A name by which some, who are fond of hard words, call the constellation Aquarius. It is the Syrian name of the sign. The Hebrews called it Deli.

DAYS. There are several different ways to count the days of the year, and they have been variously employed. Some have taken, for the beginning of the civil day, the moment of the sun rising. This was a very early custom; the Chaldæan astronomers of old time began it. Others have taken, for the beginning of the day, the moment of the sun's setting, and the Italians, and many other nations, do it at this time in all their civil computations. Others have measured the extent of the day by the time which the sun takes to return to the meridian, and this is the custom at this time received in most parts of the learned world; but with this distinction in the various computations, that, in all civil considerations, the day is supposed to begin at midnight; and, in astronomical calculations, it is supposed to begin at noon. They begin at the moment when the sun passes through the meridian, and count the four and twenty hours into the term, so that their day ends exactly at noon the day afterwards.

Notwithstanding that all these several manners of counting the days, agree together in this, that they all measure the day by the return of the sun to one of the great circles of the sphere, the horizon, or the meridian of the place where the computation is made, there is a great difference between them; for the duration of the day is not the same according to these several manners of counting or measuring it. The day is more unequal a great deal when it is counted from the rising or the setting of the sun, than when it is counted by its passage over the meridian.

It is true indeed, that, under the equator, the days, which terminate at the horizon, are the most simple, and the most equal that it is possible

possible to be, one with another, because the people, who inhabit there, have the two poles of the earth on their horizon, which, concurring with a circle of declination, cuts or intersects perpendicularly the equinoctial, and the parallels which the sun describes by his diurnal revolution: but out of the region which is under the equator, the horizon cuts these parallels obliquely; whence its follows, that the days become more and more unequal with regard to one another, the more we are removed from the equator and the polar circles; beyond which the sun appears whole days without ever setting at all, and is, for other days, hid beneath the horizon without ever rising. It is easy to see therefore that the method of counting the day by the rising and setting of the sun, is not the most universal or the best, seeing that there are places where it is quite impracticable.

It is with great reason therefore that the astronomers have taken care to determine their observations by days, which are measured by the return of the sun to the meridian, for this cuts perpendicularly the equator, in the same manner as the parallels which the sun describes in his diurnal revolution; and which are, in consequence, equal to those which terminate at the horizon under the equator.

Notwithstanding that these days, measured by the revolution of the sun with respect to the meridian, and which are those used by astronomers, are like those measured by the return to the horizon under the equator, as simple and as equal to one another as can be chosen; and notwithstanding that every day of the year be of the same extent, according to this measure, on all parts of the earth, we still are sensible of two other kinds of inequalities in them, the one of which depends upon the annual motion of the sun in the ecliptic, and which is in different degrees of swiftness, or slowness, as the sun approaches, or is distant from his apogee and perigee; and the other is caused by the obliquity of the ecliptic with regard to the equinoctial; whence it follows, that equal parts of the ecliptic, passed over by the proper motion of the sun, do answer not to equal, but to unequal parts of the equinoctial. To conceive the difference which there is between the true day and the mean day, we are to consider that the true day is measured by the return of the sun to the same meridian, which is composed of the whole revolution of the equinoctial, which is three hundred and sixty degrees more than the arc of the equator, which answers to the daily motion of the sun in the ecliptic. With regard to the mean day, which ought to be of equal duration throughout the whole course of the year, it is measured by the revolution of the equinoctial, which is three hundred and sixty degrees joined to the mean daily motion of the sun, which is fifty-nine minutes and eight seconds.

Now as the revolution of the equinoctial is a common part of the true day and of the mean day, the difference between the extent or duration of these two days consists entirely in that which there is between the mean daily movement of the sun, which is fifty-nine minutes and eight seconds, and its true daily movement in right ascention: as this is the case, we may determine immediately, and without any hypothesis, the difference between the true day and the mean day, at any time of the year, in this manner.

Having observed, on any day of the year, or particularly on any day near to one of the equinoxes, the true place of the sun, by means of taking its meridian height, or by any of the methods set down for that purpose under the article *Sun*, we may determine its true place for the same day of the year following; and we shall have its mean motion, which answers to

 the

the interval between theſe obſervations. This being divided by three hundred and ſixty-five, when it is a common year, will give the ſun's mean daily motion, which will be found to be fifty-nine minutes, eight ſeconds, and fifteen thirds.

As in every mean day the ſun runs through the whole equinoctial, or one of its parallels, which is three hundred and ſixty-five degrees more than its daily mean motion, which we have already found to be fifty-nine minutes, eight ſeconds, and fifteen thirds, we ſhall find that, as three hundred and ſixty degrees more, fifty-nine minutes, eight ſeconds, and fifteen thirds, is to three hundred and ſixty degrees, ſo is twenty-four hours to the whole time of the equinoctial taken by the ſun to return to the meridian, which we find to be twenty-three hours, fifty-ſix minutes, four ſeconds, and four thirds. This meaſures very nearly the time which the fixed ſtars take to return to the meridian.

The daily revolution of the fixed ſtars being thus known, we are to obſerve, in the courſe of the year, the hour of the paſſage of the ſun, and of ſome one of the fixed ſtars through the meridian; if the pendulum is regulated according to the mean movement, that is, if it advance exactly three minutes and fifty-ſix ſeconds a day, the difference between the time of the daily revolution of the ſun, and that of the ſtar, will meaſure, for that day, the equation of time.

If the pendulum do not advance preciſely that quantity, we ſhall find the difference from three minutes fifty-ſix ſeconds, and we are to add this to the firſt difference: if the pendulum advance more than three minutes fifty-ſix ſeconds, this is to be retrenched, and we ſhall, in the ſame manner, have the equation of time for the given day.

DECLINATION, *Circles of.* Any great circle of the ſphere, which is carried through the two poles of the earth, and through a ſtar, is called by this name, becauſe it is on theſe circles that aſtronomers count the diſtance of that ſtar from the equator. This is called its declination, and is the complement of its diſtance from the pole. *See* CIRCLES *of the Sphere.*

DECLINATION *of a Star.* A term uſed by aſtronomers to expreſs the place of a ſtar in the ſphere of the heavens, meaſured in diſtance from the equator. This circle is the ſtandard or place from which the meaſure of declination is taken, and the ſecondary circles to the equator, which are thence called circles of declination, are the means of meaſuring.

The equator, which is this ſtandard of meaſure, is a circle drawn quite round the concave ſphere of the heavens at equal diſtance from the two poles. The ſecondary circles to the equator, or, as they are uſually called, the circles of declination, are a number of circles, as many as the obſerver pleaſes, drawn through the ſeveral parts of the heavens, but all ſo drawn that they cut the equator at right angles, and paſs through both the poles of the heavens.

When the declination of any ſtar is to be deſcribed, the obſerver immediately conceives one of theſe circles of declination, drawn through the point of the heavens in which that ſtar is, and thus cutting the equator at right angles, and paſſing through both the poles; the declination of the ſtar is then ſoon known; for as every circle is compoſed of three hundred and ſixty equal degrees, the arc of this circle of declination, intercepted between the point of the heavens, occupied by the ſtar, and the equator, being meaſured, gives the declination of the ſtar. As the ſtar may be

on the north, or on the south side of the equator, the place of it is generally determined by adding the term north or south to the measure of its declination. As these circles of declination are conceived at pleasure, they are as easily carried through one part of the heavens as another, and consequently the situations of all stars are easily described by them.

DEGREE. Astronomers, to assist themselves in their measures and calculations, imagine every circle to be divided into three hundred and sixty degrees. This being understood of a circle generally considered, a degree being the three hundred and sixtieth part of a circle, is a fixed thing, and serves as a measure for the distances of the heavenly bodies: since, be the circle of what extent it will, a degree being a regular portion of that circle, bears a certain and a known proportion to its whole circumference. *See* Circle.

DELPHINUS, *the Dolphin*. One of the constellations of the northern hemisphere, mentioned by all the astronomical writers, and containing several considerable stars. It is one of the forty-eight old constellations mentioned by the Greek astronomers, and probably brought by them in the time of Thales, or about that period, from among the Egyptians.

It is of no great extent, but in proportion to the space it occupies in the heavens, it comprises a large number of stars, as well as some of considerable size. It is well that we have the name of Dolphin affixed to this constellation by all the writers who have mentioned it; for by the figure that is given of it, (and by the stars alluded to at all times as comprised in it, that seems to have been the original figure) it would not be easy to say, what fish we should call it. The astronomical designers have been, in general, too much like the herald-painters of the present time, and the animals in the heavens are no more like any on the earth, than those which we see in coats of arms. Their snakes have all got hair upon their heads, their bears have both long tails, and this Dolphin is twisted almost into a figure of eight. The Dolphin, however, has been at all times unfortunate in this respect. It is one of the straitest fish in the sea, and the least likely to twist, and bend itself about; but our very sign-painters have made it as curve as a rainbow. This Dolphin of the skies is in form a flat thick fish, with a monstrous head, a turned-up nose, in the manner of a hog; it has two large fins at the gills, and an horizontal tail; it has also a long fin down the back. The writers on natural history have disputed about two fish under this name, one of the porpus, or whale-kind, and another small one, a coryphæna. The astronomers seem to have composed their fish out of both; the fin on the back belongs to the coryphæna, the transverse tail to the whale, and the nose to common report. Howsoever this be, the head is bent a little downward, and the tail is turned up, the lower part of the body being formed into a circular bending.

The constellations in the neighbourhood of the Dolphin, are Pegasus, the Fox and Goose, the Arrow, and the Eagle, and at some distance below is Aquarius. The Dolphin occupies a space between the Horse, the Eagle, and the Fox; but the constellation might have been made larger, and there are several unformed stars that might have been taken into it. The horse's head comes very near the lower part of the Dolphin's body, the Fox is over his head, and the Eagle is on the other side of him. Below, but at a distance, are Aquarius and Capricorn.

The antients allowed ten stars to the constellation of the Dolphin, Ptolemy sets down

ſo many, and we know he was the faithful follower of Hipparchus, who made the firſt catalogue of them; Tycho preſerved the ſame account; but Hevelius raiſed the number to fourteen; and Flamſtead has added leſs to his account in this than in moſt of the other conſtellations; with him they are only eighteen. Of theſe there is not one ſtar of the firſt, nor any allowed to be of the ſecond magnitude, but there are ſeveral of the third, and they make a very bright figure; one of theſe toward the upper part of the head is particularly lucid, and perhaps deſerves, though it has not been allowed it, the honour of being referred to the ſecond magnitude. The ſtars of this conſtellation are in general about the upper part, on the head there are two conſiderable ones, and two more on the fin of the gills; there are four or five about the upper part of the body, and the reſt in general are ſituated on or about the tail, and in particular one bright one of the third magnitude is placed toward its verge, and near the middle.

Notwithſtanding that it appears moſt probable, the Greeks received the figure of this conſtellation from the Egyptians, they have, according to their cuſtom, applied a part of their own fabulous hiſtory to it, as if to convince mankind that it was themſelves who had deviſed it. They tell us, that when Neptune was in a humour to marry Amphitrite, the lady was not quite complying; ſhe fled, they ſay, and while many were in ſearch of her, one whoſe name was Delphis, found her, and uſed a great deal of eloquence in his plea to her to marry the deity; he prevailed, they ſay, and the god, in return at his death, took him into the ſea, where he gave him a new life in the form of a fiſh, one of the moſt beautiful of the deep; and afterwards, with the conſent of Jupiter, raiſed the fiſh, which had continued to be called by the name of the mortal interceſſor, into the heavens. This, however, is a round-about ſtory; there is ſomething in it out of the common courſe of transformations, and there were thoſe among the fabuliſts who were diſſatisfied enough with it to ſeek a new origin for the conſtellation.

They ſay, that Bacchus, when the ſailors, in whoſe veſſel he was, were about to run away with him, cauſed his followers to play ſome peculiar muſic, in conſequence of which the mariners danced and leaped about the deck, till at length they one by one jumped over-board; and as ſoon as they reached the ſea, were transformed into Dolphins. They add, that Bacchus, to perpetuate the memory of the event, placed one of the fiſhes in the ſkies. Others make this celeſtial fiſh the very Dolphin that received Orion on its back, and carried him to Tænarus; and, they ſay, that, for this ſervice, Apollo, who loved the muſician, placed it in the heavens. One of the ſtories has, doubtleſs, as much to do with the origin of the conſtellation as the other, and the Dolphin in the ſkies has about as much to do with the Dolphin in the ſeas.

DELTOTON. A name by which ſome aſtronomers have called the conſtellation more uſually known by the name of the Triangle. The conſtellation was formed by the Egyptians, and repreſented the figure of their country, Egypt being of a triangular form. The word Deltoti, in the Egyptian language, ſignifies a rich or fertile country.

DENTALIUM. A conſtellation offered to the aſtronomical world, and compoſed of certain unformed ſtars near the ſhoulder of Aquarius.

The creature, under whoſe out-lines theſe ſtars are compriſed, is a ſhell-fiſh, an inhabitant of the ſhallow ſeas, and is frequent in the collections of the curious. It has its name from

from the resemblance which it bears to the tusk of some animal, and is described by all who have written on natural history.

It is a small constellation, but, for its extent, it contains a considerable number of stars. The constellations, between which it is placed, are Aquarius, the Dolphin, Antinous, and Capricorn. Its open part, or mouth, is towards Antinous, and its extremity, or point, towards Aquarius. This point comes very near the shoulder of that figure, and the lower part of the bend of the shell is also near the hand, and a part of the robe. The tail, or lower part of the Dolphin, is over the open part of this constellation, but at some distance; one of the hands of Antinous is very near to the same open part, and the head of the sign Capricorn is under it at a distance, about equal to that at which the Dolphin is above it.

The conspicuous stars in the Dentalium are fifteen, and they are disposed, as it were, in four clusters at some distance from one another. The first cluster consists of five, and marks the mouth, or opening. One is placed at each limit of the shell, but these are both small ones. The three others are situated between these, and are larger, two are nearly upon a level with one another, and the third is lower on the shell. The second cluster consists of three little stars, it is at some distance above the middle of the shell, two of them are near together, the third is single, and is a little above these, and something larger. The third cluster is also of three, this is somewhat beyond the middle of the shell, and these are placed nearly at an equal distance from one another; one of these is on each out-line, and the third nearly in the midst of the shell. The fourth cluster consists of four stars, or rather of two lesser clusters, of two each. The first two are small, and at some distance from one another, they stand at a small space from the extremity of the shell; the other two are almost close together, and are very near the point of the extremity: these are just over the shoulder of Aquarius; and the third cluster is almost immediately over his hand.

DERCETO. A name by which some called the constellation Cetus, the Whale. This is a name of the Syrian idol Dagon, which was represented part human and part fishy, and possibly the head and hands of this constellation may have been originally human, and only the tail fishy, as we see it at present. The upper part, though not human, is not at all fishy, it is rather that of a quadrupede.

DEUCALION. A name given by some of the old writers on astronomy to the constellation Aquarius. It was supposed to be the figure of that old king of Thessaly exalted into the heavens, and the urn with the water coming from it, was called an emblem of the deluge of his time. *See* AQUARIUS.

DIAMETER *of a Circle*. This is the term used to express a strait line drawn from any part of the circumference of a circle, carried through the centre, and continued to the circumference on the opposite part. This always divides the circle into two halves, or semicircles. *See* CIRCLE.

DIAMETROS. A term we meet with in the old Greek astronomers favouring the doctrine of astrology, signifying what they called one of the five aspects of the planets and constellations, or of the planets and fixed stars. The Diametros of the Greeks was what the Latins called Oppositio, and what our astrologers, at this time, call also Opposition. The situation, in which the planet and star are found

in

in this aspect, being at one hundred and eighty degrees, or half a circle, distance. The other four aspects were the conjunction, or synodus, when the planet and star were together. The sextile, or hexagonus, when they were sixty degrees distant; the quadrate, or tetragonos, when they were at ninety degrees distance; and the trine, or trigon, when they were at one hundred and twenty degrees.

In all these aspects the antients supposed the planet and the star, or stars, shed mutual influence, or received reciprocal radiations from one another, and that from this they co-operated together in modelling the events of sublunary things. From these they presaged the fate of kingdoms, and the fortunes of private persons.

DIDYPOI. A name by which the Greek writers have sometimes called the constellation Gemini.

DIOSCURI. A name by which some of the Greeks have called the constellation Gemini.

DIPHDA, *or* DIPHDA AL AUWAL. A name by which some, who are fond of hard words, have called the star of the first magnitude in the southern hemisphere, which is at the bottom of the water of Aquarius, or in the mouth of the southern fish. They also call it Phomal Hault, which is spelt commonly Fomahaut, and signifies the mouth of the fish. The term Diphda Al Auwal signifies Rana Prima, or the First Frog.

DIPHRELATES. A name by which some, who are fond of uncommon words, call the constellation commonly known by that of Auriga. It is one of its old Greek names.

DISTANCE *of an Object.* Opticians confine this term, vague as it is in its nature, within certain bounds: though these also are, in themselves, indeterminate enough, yet they serve to limit it a little. When the surface of a lens, or magnifying glass, which is turned towards an object, is small, compared with the space between the object and the lens, that object is said to be distant from the lens. In the same manner an object is said to be distant from the eye, when the aperture of the pupil of the eye is small in comparison with the space between the eye and the object.

DISTANCE CIRCLES, *or* CIRCLES *of* DISTANCE. A term used by astronomers to express certain great circles of the sphere, by means of which they measure the distance of any two stars, or any two points in the heavens, and by which they also measure the diameters of the larger luminaries, as they occupy the space between two such points by their bigness. The use of the circles is very evident and very great, but, in order to understand them perfectly, we must have recourse to certain other circles.

In the first place, we are to understand what is that great circle the horizon, which, dividing the whole concave of the heavens into two hemispheres, shews the place in one of them where the points to be measured are situated; and, after the explaining, in a few words, the nature of those circles of two kinds which have immediate reference to this, we shall easily lead the most unexperienced to the meaning ot this circle of distance, and put him into a way of dividing and portioning out the heavens with all possible, at least all necessary, precision.

In the first place then, the horizon is a great circle of the sphere, whose plane passes through either that point of the surface of the earth on which the observer stands, or else through the centre of the earth parallel to it. In the first

of

of theſe caſes it is called the ſenſible horizon, in the other the rational horizon. Theſe might ſeem two circles of great diſtance from one another in the heavens, in as much as they are, in reality, at the whole diſtance of a ſemidiameter of the earth, aſunder. But although this be a very great thing with reſpect to us, yet it is ſo perfectly nothing with regard to the ſphere of the heavens, in which the fixed ſtars are placed, that theſe two horizons coincide, and make only one, their diſtance being not to be perceived in the niceſt obſervations, or diſtinguiſhed by the beſt inſtruments. Nor is this a wonder, when we conſider the earth to be, as it truly is, a point only, or a thing of no meaſurable quantity in reſpect to that part of the ſphere in the heavens, in which even the fixed ſtars which are neareſt to us are placed. In effect then, not to make confuſion, by diſtinctions about it, there is no viſible difference. If a man, ſtanding on a flat ſtone in a pavement, conceive that ſtone to be extended every way in a circular form, ſtill retaining its flatneſs, and to terminate at its edges at the region of the fixed ſtars; that extended plane, which would then be a circle, the plane of which paſſed through the point of the earth's convex ſurface on which he ſtood, will be the horizon of the place. This will divide the concave of the heavens, as before obſerved, into two hemiſpheres, and, the one of theſe, being above the horizon, would be viſible, the other, below it, inviſible, to him, becauſe of the intervention of the earth's ſurface. Theſe two hemiſpheres are, from this ſituation, and theſe circumſtances, called the upper and the lower, and the viſible and the inviſible, hemiſphere. Thus are underſtood what is the horizon, and what mean the terms expreſſing its diviſion.

All the ſtars in the upper or viſible hemiſphere are above the horizon, as all thoſe in the lower and inviſible hemiſphere are below it. But this is only a general diſtinction. Aſtronomers, on many occaſions, want to know how much theſe ſeveral ſtars are above, and how much they are below this horizon; and at what diſtance they are, not only from the horizon, but from one another. On the determination of this reſts a very great part of aſtronomy, and this is done by means of certain circles, of which theſe circles of diſtance are ſome.

In the firſt place then we are to underſtand, that the point of the heavens which ſhall be immediately above the head of the perſon ſtanding on this pavement, and the point in the lower or inviſible hemiſphere, which is immediately under his feet, muſt be the poles of that horizon, in the centre of which he ſtands. The point above his head is called the upper pole and the zenith; and the point under his feet is called the lower pole, or the nadir. Now, whatſoever circles are drawn through the poles of any other circle, are diſtinguiſhed by the name of ſecondary circles to that. When we would meaſure the altitude of any heavenly body, we can only do it by means of ſome circle, conceived to paſs thro' theſe poles of our horizon: of theſe circles we may form as many as we pleaſe, for they are all imaginary, and when they are thus formed, they are ſecondary circles to the horizon. It were greatly to be wiſhed, that theſe plain and expreſſive, and therefore inſtructive terms, were to have been continued, but we are to know, that theſe circles are called azimuths. And to meaſure the height of the ſun, or of any ſtar by an azimuth, is to do it by an arc of one of thoſe ſecondary circles.

Beſide theſe vertical circles, or azimuths, there are another ſort of circles dependent alſo on the horizon: theſe are parallels, and they are called by another hard name Almicantarahs. Theſe are drawn above the horizon, if

if in the visible hemisphere, and parallel with it, all the way up to the pole or zenith.

It follows from this short explication of the azimuths and almicantarahs, that the former being vertical, and passing through the poles of the horizon, must be all equal: and, on the contrary, that the almicantarahs being only parallel to it, and at different heights between it and the zenith must be unequal. This is the case: for they are larger, as they are nearer to the horizon, and smaller, as they are nearer to the zenith above, or to the nadir below: for though it is the custom for plainness to speak only of the upper, or the visible hemisphere, all is understood to refer also to the lower or invisible.

The horizon, its parallels, and its verticals, being thus understood, there will be no difficulty to conceive what is meant by circles of distance, which are circles conceived in the sphere of the heavens, and passing through parts of the upper hemisphere, and are neither azimuths nor almicantarahs, neither verticals nor parallels, but oblique.

We have seen, that, in order to measure the altitude of a star above the horizon, the method is to conceive a vertical circle or azimuth; and, after taking the place of the star in the heavens, to measure the arc of that circle which is intercepted between the place of that star and the horizon. This arc of the azimuth gives the altitude of the star, for it is just so many degrees high, as there are in this arc of that vertical circle. But we may also have occasion to know what is the distance between two stars which are in two different parts of the heavens, and this neither the azimuths nor almicantarahs will shew us, since it cannot be determined upon circles that are either vertical to, or parallel with, the horizon. Now as all distances, in the schemes of the heavens, are to be measured only upon great circles of that sphere, it becomes necessary, in order to determine the distance between these, to conceive a great circle of the sphere to be so drawn that it shall pass through both of them. A circle, thus conceived, is, from its use in measuring the distance between the two stars through which it is drawn, called a circle of distance. And the stars are to be measured in this respect as in altitude, by measuring the arc of this circle of distance that is drawn through them, for so many degrees as are contained in the arc of this circle intercepted by them, so many degrees are also the measure of the distance of those stars from one another.

But this is not all the use of these circles of distance, they may serve also to measure the diameters of the larger luminaries. For instance, let us suppose one of the circles of distance, drawn through the centre of the sun, we shall easily see that the two opposite limbs or verges of the sun, which are cut by the circle, are two points distant in the same manner as the places of the two stars in the former instance, and that nothing more is necessary in order to measure the sun's diameter, than to take the arc of that circle, intercepted betwen the one and the other limb of the sun's disk; and that the measure of this arc, must be in the same manner the measure of the sun's diameter.

DISTANCE *of the fixed Stars*. When we cast our eyes in the night up to the concave of the skies, we see a number of stars, different in magnitude and in lustre. It is easy to separate the planets from the fixed stars by their steady light, none of them, except Mercury and Venus, having any thing of that vivid lustre, or twinkling to the eye, which we see in the fixed stars; and even they, but very little of it; and the comets, when they appear,

pear, having yet more dead or faint light, than the most remote of the planets.

The fixed stars being thus distinguished from all the other heavenly bodies, it remains to regard them as varying from one another; this is only in apparent magnitude, and in the degree of that brightness which is peculiar to them as fixed stars. This distinction is in the general in an equal degree in both respects, but not universally, and without exception. Those of the fixed stars which appear largest, appear also brightest, and the smallest faintest: this would refer the difference in apparent magnitude to distance only, but there are some exceptions. We know that distance diminishes light as well as bigness, but there are the Syrius, Aldebaran, and some others, which shine with a lustre greatly superior to the others, that are of equal apparent diameters; therefore there is some difference in the brightness of their fire. Thus much settled, when we consider the apparent bigness of the fixed stars, we naturally enquire also into their different distance from the earth. We see these two considerations too intimately united to be separated in our minds, for they depend in such a manner upon one another, that when the one is determined, the other naturally results from it. Geometry, a science of continual use in the study of astronomy, convinces us, that in measuring the apparent diameter of an object, that is, in precise terms, the measuring the angle it makes with the eye, we may, on knowing its distance, determine what is its real magnitude, or reciprocally, if we are assured of its real magnitude, we may discover this way its distance.

Now to bring this to use in astronomy, we can, with a sufficient degree of accuracy, determine what are the apparent diameters of the sun, moon, and planets, and this with no great trouble, their disks being determinate, and well seen. But it is otherwise with regard to the fixed stars; we find it extremely difficult to measure their apparent diameter, because of the vivacity of their light, and the rays they continually send forth; that twinkling which they have when seen by the naked eye, not being easily quite excluded in astronomical observations, and even when it is, their edges being by no means determinate. This is a consequence of their being in themselves bodies of fire, and not receiving their light, as the moon and planets do, from the sun, and sending it to us only by reflection.

The most familiar manner of determining, with any degree of exactness, the different magnitude of these stars, in order to the speaking of them in that respect, is by comparing them with the diameter of some other heavenly body of known dimensions. Jupiter may be chosen for this purpose, as that is the planet of which we most certainly know the dimensions, the moon and sun excepted, whose apparent bigness is too much superior to render a comparison familiar or convenient. Now for a first consideration, with this view let us select the most conspicuous and the brightest of the fixed stars of our horizon, let us fix upon Sirius, or that in the Great Dog. In order to view this distinctly, apply a telescope of some considerable power, suppose one of the refracting kind, of thirty-four feet in length, and to take off some of the rays, and render the view more precise, it is proper to cover the object-glass of this telescope with a paper, having only a hole of an inch and a half diameter in the centre. When Sirius is viewed through a telescope of this power, and with this stricture upon the object-glass, his disk will be seen very clear, and all that twinkling or sparkling of rays, which confound the sight, being cut off, his circumference will be determinate. We suppose the time of this observation chosen so

that Jupiter may be, at the ſame time, above the horizon, to be ready as the object of comparison: immediately after viewing Sirius, the teleſcope is to be directed to that planet. When this has been carefully viewed, the teleſcope is to be again directed to Sirius, for the difference is much more plainly ſeen in turning from a larger object to a ſmaller, than from a ſmaller to a larger. The alternate obſervation is to be ſeveral times repeated, and the reſult will be, that Jupiter appears ten times as large as Sirius. This will ſerve our purpoſe. We know the apparent diameter of Jupiter to be fifty ſeconds, and conſequently that of Sirius, being only one tenth of that meaſure, is five ſeconds. This is not ſpeaking with a perfect preciſion, but it is ſufficient.

We know then the apparent diameter of Sirius: what we were to enquire was the real bigneſs of that ſtar. This, if we can find what is its diſtance from the earth, will be known by the rules of geometry from this diameter, or the angle it makes with the eye as thus ſeen. This will be a ſhort method, and an eaſy one, when that diſtance can be found; but at preſent this is one of the deſiderata in aſtronomy. It is certain, that all trials to find the diſtance of the fixed ſtars have hitherto been vain. The parallax would have done it effectually, could we have abſolutely diſcovered any, or could we have diſcovered ſuch as ſhould have been ſufficient for meaſuring; but it muſt be confeſſed, that all the accuracy of aſtronomers has not certainly diſcovered that they have any, or if any has been ſet down, it is ſo little, that it ſeems more probably owing to errors in the obſervations, than to any thing in nature. All that we certainly know on this head, all that is received as certainty by aſtronomers, is, that they are greatly more remote than all the planets. Their diſtance therefore muſt be immenſely great, that of Saturn being about three hundred millions of leagues, or an hundred thouſand times the diameter of the earth.

To do all that can be toward finding ſomething out with regard to the magnitude of the fixed ſtars, let us ſuppoſe the apparent diameter of Sirius, what we have allowed it, that is, five ſeconds. If Sirius, whoſe diameter is five ſeconds, were at the ſame diſtance from the earth with Saturn, we ſhould eaſily find his true diameter; this would be as the total ſinus is to a ſinus of five ſeconds, ſo three hundred millions of leagues are to ſeven millions of leagues, which are the meaſure of its diameter, which exceeds more than twice the diameter of the earth, and which, notwithſtanding, is the leaſt that it is poſſible to aſſign it, according to whatſoever ſyſtem of the world we ſhall chuſe.

Now if, with the generality of aſtronomers, we agree, that the fixed ſtars are of the ſame nature with the ſun; that they are, like that, bodies of fire, and luminous in themſelves, and that they are alſo nearly of the ſame magnitude, (the diſtance of the ſun being about ten thouſand diameters of the earth, and the apparent diameter of Sirius being to that of the ſun only, as one to three hundred and eighty-four) we ſhall, on theſe principles, have the diſtance of Sirius from the earth fixed at three millions eight hundred and forty thouſand diameters of the earth.

This being received as the diſtance of Sirius, which is the brighteſt and moſt conſpicuous of all the fixed ſtars, we muſt ſuppoſe that of the other fixed ſtars to be in general greater, and that of a great many of them immenſely greater. In ſpeaking upon theſe ſubjects, where we have ſo few data, we muſt argue, in a great meaſure, on conjecture; but if we agree with the generality of philoſophers and aſtronomers, that the fixed ſtars are all of the ſame,

ſame, or nearly of the ſame, magnitude; when we view, at the ſame time with Sirius, which is ſo bright and ſo large, the numbers of others which appear ſo faint and ſo minute, we muſt ſuppoſe their diſtance to be immenſely greater than that of Sirius from the earth. This is not confined alone to thoſe which appear to the naked eye, for when we have taken the advantage of a clear night to ſee all that the naked ſight will diſcover to us in the heavens, if we direct a teleſcope to almoſt any part of them, we ſhall, by its means, diſcover others too minute to be ſeen by the unaſſiſted organs. If it be true, that all are of equal ſize in themſelves, and they only look ſmall in proportion to their diſtance, what and how immenſe muſt be that diſtance in theſe? We have ſettled that of Sirius at three millions eight hundred and forty thouſand diameters of the earth; the leſſer ſtars we ſee by the naked eye, muſt be at an immenſely greater diſtance from the earth than Sirius, and what muſt be the diſtance of theſe? When we have viewed, in any part of the heavens, the number of thoſe which are not to be ſeen by the naked eye, and appear to our teleſcopes, if we apply ſuch teleſcopes as are of larger power, and direct them to the ſame parts of the heavens, we diſcover yet other ſtars which are too minute to be made viſible by the firſt, and this without any end or ſtop: our inſtruments at length fail us, but the works of this part of the creation never. All theſe muſt be yet more and more remote in proportion to their minuteneſs as ſeen from the earth. What numbers then could convey the diſtances of the laſt, or of thoſe yet unknown, which we fail to ſee in our moſt accurate reſearches, for want of yet more powerful inſtruments. The more we ſee of the works of the creation, the more we muſt admire and adore its Author. It does appear that the unbounded ſpace is filled at proper diſtances with theſe ſtars: each of theſe is a ſun; and if we continue the inquiry, reaſoning by analogy, we ſhall determine that each of theſe ſuns has earthy planets rolling round it, for to what end elſe ſhould they have been created? In this view, what, and how amazing is the ſtructure of the univerſe!

Some of the teleſcopes which are uſed to this purpoſe, magnify to ſo powerful a degree, that they make objects appear two hundred times greater than they do to the naked eye. Now as calling Sirius a ſtar of the firſt magnitude, the diameter of the ſmalleſt of thoſe which we ſee with the naked eye, is but about a ſixth part as large as that of Sirius; conſequently, ſome of thoſe which we diſcover with our teleſcopes appear twelve hundred times ſmaller than Sirius, and the other largeſt fixed ſtars. If, therefore, we allow the fixed ſtars to be all of the ſame bigneſs, we muſt conſider theſe ſtars as twelve hundred times the diſtance of Sirius from the earth, and the diſtance of that ſtar we have already fixed at three millions eight hundred and forty thouſand times the diameter of the earth.

Vaſt as this appears, it is the leaſt diſtance we can allow to the fixed ſtars, whatſoever method of computation we uſe. If we take the ſyſtem of Copernicus for our guide, and conſider this diſtance on the principles of that certain theory, we ſhall find it yet vaſtly greater than at this computation. It was this immenſe diſtance of the fixed ſtars from the earth, that reſulted from the Copernican ſyſtem, which made Tycho Brahe depart from it, and form another of his own, to ſolve the matter on leſs amazing conſiderations. But the error of his ſerves to eſtabliſh the truth of the ſyſtem he meant to invalidate, and is a proof, collaterally, of the reality of this yet more immenſe diſtance. The Copernican ſyſtem, to which men, at this time, adhere, and which

the name of Newton has rendered sacred, supposes the sun and the fixed stars to be immoveable in their places. The earth makes a revolution about its own axis in twenty-three hours and fifty-six minutes, and from this motion of the earth, which, as every thing about us moves with it, we do not perceive, results the apparent diurnal motion of the sun and stars round the earth. This naturally seems to be from east to west, because the revolution of the earth upon its axis is from west to east. The earth, according to the same system, performs also an annual revolution round the sun in the space of a year, describing, in this revolution, a circle which is called the ecliptic, or the annual orbit of the earth. There is also, beside these, an apparent motion of the fixed stars, which tends to form a revolution round the poles of the ecliptic. This apparent motion of the fixed stars is accounted for in the same system by a motion almost invisible of the earth about that circle; a complete revolution of which will be performed in about twenty-six thousand years. It is plain then, that, according to this system, the earth does, in the space of six months, run through half of her annual orbit, and is carried, in this motion, oppositely to the place from whence it set out, and from which it is consequently distant the double of its distance from the sun, that is about twenty thousand diameters of the earth. We see then, that the same star, viewed from the earth at any certain time, and again viewed at the distance of six months, although it be observed from the same spot of the earth, is yet seen from a place in the universe at a vast distance from that whence it was first viewed, at a distance no less than seventy thousand times the diameter of the earth; for the earth has, in that time, changed her place in no less a space. This is an immense distance from the first spot; it is indeed so great, that the two angles are of no less than ninety degrees each. The star seen from the earth, when in its first place, or in the place where it was when the first observation was taken, will appear to answer to a certain point of the firmament at an infinite distance; if, after this, we observe its place, or the point of the firmament, to which it answers at the second observation, made when the earth, from whence we view it, has made half its annual revolution, and compare the angles, it will be easy to compute so as to find the distance yet infinitely greater; for if, instead of the star being in the ecliptic, we suppose it placed at one of the poles of that circle, and continue the observations, the result will be, that the stars, which are on the ecliptic, have no parallax in latitude, and that what they have in longitude is according to the direction of the plane of the ecliptic. When the best possible methods have been employed to discover the parallax of the fixed stars, whatsoever has appeared to favour the opinion of their having any, seems, as said already, to a judicious enquirer, rather the result of some little error in the observation, or of the very aberration of light, than in the thing itself; and the consequence of this is, that the distance of the fixed stars from the earth is so immensely great, that the whole diameter of the earth's orbit, the extent of which is about sixty millions of leagues, is as a point to it, or cannot be considered in any degree of comparison. According to this, the real distance of the fixed stars, even of the nearest of them, is great beyond all computation; and there is all the reason in the world to conclude, that those, which appear smaller and fainter to the eye, are, in reality, more and more distant in a degree proportioned to that first distance. There are some who allow the largest of the fixed stars no apparent diameters, but this seems carrying it too far.

DOG. One of the conſtellations of the northern hemiſphere. *See the article* CANIS.

DOLPHIN. One of the conſtellations of the northern hemiſphere, ſituated near the Eagle. *For an account of the number and ſituation of the ſtars, ſee the article* DELPHINUS.

DORADO. A name given by ſome to the conſtellation of the ſouthern hemiſphere, more commonly called the Sword Fiſh; but thoſe who have formed the conſtellation, and thoſe who have thus named it, ſeem to have had very little knowledge of the fiſh they meant to repreſent in the delineation, or by the denomination. Dorado is not the name of the Sword Fiſh, nor is the figure they give of that ſpecies: they call it Xiphias, or the Sword Fiſh, and the figure is of the Serra Piſcis, or Saw Fiſh. *For the ſtars compriſed under it, ſee the article* XIPHIAS.

DOVE, *or* DOVE *and* OLIVE-BRANCH, COLUMBA NOACHI. One of the new ſouthern conſtellations. It is ſituated near the hinder feet of the Great Dog, and contains ten ſtars. *For an account of the ſituation of theſe and their ſize, ſee the article* COLUMBA NOACHI.

DRACO, *the Dragon*. One of the conſtellations of the northern hemiſphere, and a very conſiderable one among them. It is one of the forty-eight old aſteriſms, and we find it named by the earlieſt writers who have profeſſedly treated of aſtronomy. It is probably of Egyptian origin, and was received from them by the Greeks, among whom we find it firſt mentioned; for the creature of this form is, though not in nature, very common in their hieroglyphical writings. The Greeks, however, have deviſed fables for its origin, as is their cuſtom with regard to the reſt.

It is a conſtellation of very great extent, and contains a conſiderable number of ſtars, and many of them large ones. Its body is thrown into convolutions in order to receive them properly, and it is repreſented as a ſerpent of enormous length with a head ſomewhat like that of a bird of prey; but without wings or feet. The head is large, and has a pair of ears; the body has three of thoſe convolutions already mentioned, one of them very near the head, the fartheſt at a conſiderable diſtance from the tail, and the other at about the intermediate point between them. The whole body is alſo bent, and carried in varied directions.

The Dragon is ſurrounded by the conſtellations Cygnus, Lyra, Cepheus, and the two Bears. The foot of Hercules, and the tip of one of the Swan's wings, come near its head. Great part of its body runs by the right arm, right leg, and right ſide, of Cepheus; and its tail is carried up between the Greater and the Leſſer Bear, running almoſt parallel with the back of the greater, and perpendicularly to the face of the leſſer.

It is, like many of the conſtellations, a creature of the aſtronomers invention, for there is nothing like to it in nature, but the ſtars are very happily contained within the outline of its body. The Greeks were very well acquainted with it; we find they allowed thirty-one ſtars to it; Ptolemy gives ſo many in his catalogue; Tycho makes them thirty-two; Hevelius counted forty, and Flamſtead eighty in it. There are three or four very bright ones about the head; the reſt are diſpoſed, in ſome few places, in a double line, but in the greateſt part in a ſingle line along the body.

The Greeks tell us that this was the famous dragon of the Heſperides, the creature that guarded the golden apples there, and which was killed by Hercules. They ſay that Juno, in reward for its faithful ſervices, when it was ſlain by that hero, took him up into the heavens, and made this conſtellation.

Others

Others give it another origin; they ſay, that, in the war of the giants, this dragon was, by thoſe earth-born enemies of the gods, brought into the combat, and oppoſed to Minerva: the goddeſs, they add, taking the dragon in her hand, threw him, twiſted as he was, up to the ſkies, and fixed him to the axis of the heavens, before he had time to unwind his contorſions. The Greeks are, in many things, thus uncertain and various in their accounts; we do not know that they had any right to the denomination of the ſign, becauſe probably they received, it with the reſt, from Egypt, in the time of Thales; but, if otherwiſe, the foot of Hercules, coming upon the head of this conſtellation, ſeems to give it more title to be thought the Heſperian dragon; unleſs, as ſome ſay, that conſtellation do not ſo properly repreſent Hercules as Ceteus, whom they make father of the nymph turned into the Greater Bear. If ſo, this may, if the fabuliſts pleaſe, as well be the dragon of Minerva.

Although this conſtellation is not mentioned by Homer and Heſiod, who have named the Pleiades, Orion, Sirius, and ſome others, it will be found, on inquiry, that it is a very antient one. It has been ſuppoſed, from this omiſſion, not to have been known to the Greeks at thoſe times; but if that be the caſe, (for their ſilence is no proof) yet its not being known to the Greeks is no proof of its not being then formed. We find that they received the rudiments of their aſtronomy from the Egyptians, and they did not receive it all at once: they had the conſtellations from the ſame ſource, but they had them not all at a time. The Draco, therefore, might be in uſe, and familiar among the Egyptians, and in other places, although not known to them, and we have indeed proof that it was ſo; for whatever regard we may pay to the deeds of Hercules, and to the hiſtory of that dragon which guarded the Heſperian fruit, we ſhall find this is the conſtellation mentioned in the book of Job under the name of the Crooked Serpent.

There have been ſome who have ſuppoſed this expreſſion to mean the ſerpent of the earth, but that is idle, for it is mentioned as one of thoſe things which beautified the heavens. Others have imagined, although they allowed that it meant ſomething in the heavens, that the zodiac was intended by it. Others have thought it alluded to the Milky Way, but neither of theſe is at all like a ſerpent, or has a title to the epithet tortuous, which is the exact tranſlation of what we render by the word crooked. There is no queſtion that a conſtellation was intended by it; there is no queſtion that the author, who had all the conſtellations of the heavens to chuſe out of, would mention one that was uſeful to mankind, as well as ornamental to the heavens. The ſituation of Draco, near to the north pole, rendered it very fit to be obſerved, and the old authors, who ſpeak of it, name it as one of thoſe which ſailors and huſbandmen regarded.

DRAGON. The name of a conſtellation of very conſiderable extent near to the north pole; it is near to the Little Bear, Cepheus, and Cygnus, and has been juſt deſcribed under the article Draco.

Draco is alſo a name given by ſome to the Serpent between the legs of the conſtellation Ophiucus, which is ſuppoſed to repreſent one of Triptolemus's dragons of his chariot, periſhing under the hand of Carnabos; but that is more uſual, as well as more properly, called the Serpent. *See* SERPENS.

DUL. A name by which ſome, who are fond of hard words, have called the conſtellation Aquarius. It is the Perſian name; the Hebrew is Deli, and the Arabic Al Delu.

DUPLE

D U

DUPLE RATIO. That ratio which is between two numbers, the antecedent in which contains the consequent precisely twice. Thus in the numbers eight and four there is a duple ratio.

DUPLICATE RATIO. When the ratio between two second powers, or squares, is considered, it is thus called. *See* RATIO.

DUSARES. A name by which some, who love uncommon words, call the sun. It is one of the old Arabic names, and it signifies properly the seer of all things.

DUSHIZA. A name by which fanciful people have called the constellation Virgo. It is the Persian name of the constellation, and it is idle for us to use it.

E.

EAGLE. One of the conſtellations of the northern hemiſphere. Some alſo call it the Vulture. It is ſuppoſed to have been the bird that preyed upon the liver of Prometheus; and the arrow, that is juſt above it, to have been that with which Hercules ſhot it. *See the article* AQUILA.

Schiller, who has new-modelled all the conſtellations, in order to make them refer to ſome parts of the Chriſtian hiſtory, has placed a female figure inſtead of this, and calls it Catharine.

EAST. That half of the horizon, according to the diviſion made of the horizon into two parts by the meridian, in which all the ſtars riſe, is called, in general, the eaſt; as that other half of it, in which they ſet, is called the weſt in general; but, when we ſpeak of the eaſt point, we are to diſtinguiſh more accurately. That point of the horizon, which, in its interſection with the meridian, is neareſt to the ſouth pole, is called the ſouth point, and that which is neareſt to the north pole is called the north point; and the two points in the horizon, which are at equal diſtances from theſe two, are called eaſt and weſt.

We often uſe the terms eaſt and weſt as if abſolute, when they are only relative. Thus, in ſpeaking of the meridians, we ſay, that a meridian divides the earth into two hemiſphers, an eaſtern and a weſtern, as the equator divides it into two hemiſpheres, a northern and a ſouthern. But in the thing there is a great difference, though not in the terms. The north and ſouth hemiſpheres are fixed things, and that place, which is ſaid to be in the northern hemiſphere, is always, and in all reſpects, in the northern hemiſphere; but it is otherwiſe with reſpect to thoſe ſaid to be in the eaſtern or weſtern; for although the equator is but one circle, the meridians may be a thouſand, and conſequently that place may be in the eaſtern hemiſphere with reſpect to one meridian, which is in the weſtern with reſpect to another. The terms eaſt and weſt are, in general, relative, and a place may be eaſt with reſpect to one part of the world, and weſt with reſpect to another. The true and certain points of eaſt and weſt are, with reſpect to any particular place, thoſe places where the horizon is interſected by the equator. This is the true and determinate eaſt of that place; but, in ordinary ſpeaking, aſtronomers give the name of eaſt to all that half of the circle of the horizon, in the middle of which the eaſt point is. The ordinary way of ſpeaking is to divide the horizon into two parts, the eaſt and the weſt; the eaſt is that where the ſun and ſtars riſe, and the weſt is that where they ſet. This muſt be the caſe, ſeeing that the rotation of the earth is from weſt to eaſt: for the apparent motion of the heavenly bodies, owing to that, muſt be in a contrary direction, that is, from

eaſt

east to west; so that, dividing the circle of the horizon there into two parts, an eastern and a western, as the whole globe of the earth is divided by a meridian, the sun and stars must be found to rise in the east, and set in the west.

EASTERN, OR ARABIAN ASTRONOMY. A term very frequent in the writings of certain astronomers, and expressing that part of the science which was known in Arabia, and the manner in which it was studied and inculcated.

There is some reason for the term, for the science was received in a different form among that people, and obtained many peculiar regulations, and, in some parts, many changes; but they err extremely who place the date of these very high, or suppose the improvements or additions the Arabs made were of any early date: yet this is a very common error.

In the first place, the astronomy of the Arabs is later than that of the Greeks, whatever may have been imagined by some. The Greeks received the rudiments of the science from the Egyptians, and the Arabs from the Greeks: nay, and this not in the earliest times of the Greek knowledge, but after it had become received from age to age, from the time of its first introduction into that country.

That this is the case is certain; for the very Arabic names of the principal constellations are no other than translations of those names by which they are called by the Greeks. And sometimes, instead of translations, they are words of the same sound, or are the same words, with no more difference than that of the Arabic manner of pronunciation, or the common addition of the particle Al. Thus the constellation Cetus, the Ketos of the Greeks, is called, in the Arabic, Alketus, and of the other kind instances are very familiar; in the name of the Raven, which, being called by the common name of that bird Corax in the Greek, is, in the Arabic, called Al Gorab, the common name of the same bird in that language; and the name of the Serpent being in the same manner in the Arabic, the word that expresses a long and slender snake.

That they preserved, in general, the forms as well as the names of the constellations just as they received them from the Greeks, is very certain, and in every other part of the science, although in some they have made very great additions, the same will appear to be the original. Indeed the very dates of the several improvements and additions will serve to ascertain the thing in the same manner.

To take no notice of the claim to remote antiquity made by the Egyptians, Chaldæans, and Babylonians, which is most probably false, and the offspring of a foolish ostentation, we shall find that, long before the first acquaintance of the Greek astronomers with the science, the Egyptians were absolutely in possession of some part of its rudiments. They had arranged the fixed stars, in several places, into constellations, and they had accustomed themselves to watch their risings and settings as useful to them in their religious ceremonies, and in their civil concerns. They had observed them so long, and so carefully, as to find their heliacal risings to be the presages, or, in other words, to be the natural forerunners of certain changes in the seasons; and they had long before the earliest acquaintance the Greeks boast with them, made voyages. If these were not long ones, at least they were out of sight of land, and that was enough to give them opportunity, nay, and to introduce a necessity of observing some fixed stars toward the pole. They found that the Dog-Star rose heliacally at a certain time of the year, and that there constantly followed violent heats; they found also that the seven stars rose heliacally at an-

other, and that this was always ſucceeded by rains. They ſaw the ſame riſing of other conſtellations annually return at a ſeaſon when it was proper to ſow their corn, or to bring forth the young of their flocks and herds to enjoy the warm ſun, and fatten upon the paſture; and they expected the riſing of theſe conſtellations as the notices that they were to do theſe things. They alſo marked the ſtars about the pole, arranging them into conſtellations, the Bear's, or Wain's, or be they what they would; and theſe were their marks when out at ſea, and alſo when in long land travels they had ſandy deſarts to croſs of vaſt extent, and without any trees, or mountains, or buildings, to ſerve as a direction, for many leagues together.

At what exact period this firſt knowledge of aſtronomy was eſtabliſhed, is impoſſible to ſay. But although it cannot be ſuppoſed ſo remote as their romantic accounts pretend, yet we find it very early; we find the prophet Iſaiah mentioning ſome conſtellations, and the prophet Amos others. Theſe are writers whoſe date is eaſily known, becauſe they tell us the names of thoſe kings under whoſe reigns they propheſied, and we find that by this they were nearly cotemporaries, and were near eight hundred years prior to our Saviour. They ſpeak of conſtellations familiarly, and as known things at that time, and it is palpable, they were therefore known long before, and that among the Egyptians. If we thus ſuppoſe the origin of aſtronomy to have been, or, to ſpeak in more expreſs terms, if we allow aſtronomy to have been known to the Egyptians a thouſand years before the Chriſtian æra, we ſhall find it there much earlier than we have any trace of it in Greece; nay, we ſhall find their aſtronomers, who are acknowledged to have brought their rudiments of it firſt from thence, to have been later than this period by near five hundred years.

If we examine ſtrictly into the ſituation of Egypt, and the diſtribution of the ſigns of the zodiac, and their appropriation, or intended appropriation, to the ſeaſons of the year, we ſhall find that they agree ſo ill with Egypt, and ſo well with other countries, that Egypt is the laſt of all places in the world in which we can ſuppoſe they were invented. This will be more properly a ſubject of enquiry when the conſtellations are treated of; in the mean time it is enough that here is proof of the Egyptians being, with reſpect to the Greeks, the inventors of the ſcience; and not the Arabians, as ſome have been ſo abſurd to imagine.

We ſhall now have opportunity of tracing it to the Arabians: we find it evident, that the very names, by which the conſtellations are called in that language, are derived from, or are tranſlations of, thoſe of the Greek, and conſequently it was from theſe people, who, five hundred years after the time when we find aſtronomy known among the Egyptians, borrowed it from that people, that the Arabs ſo idly ſuppoſed its inventors abſolutely learned it. Nay, and on enquiry, we ſhall find that they did not learn it of theſe ſo ſoon as their maſters became poſſeſſed of it, but long after.

We find them a very rude and uncultivated people till times that are very late, in compariſon with even the Greek period of aſtronomy. It was only about the time of their prophet Mahomet, or a very little before, that the uſe of letters came among them; they even till then were the rudeſt people of the eaſt, and where is the probability that they ſhould inſtruct others? It is poſſible that they might, before this time, have made ſome obſervations of the ſtars, and even have arranged them into conſtellations; but it is not probable, for they adopted all the Greek ones: and we find

none

none but the Greek, or those which are of Greek origin, among them; whereas if they had before had any of their own, it is probable they would have mixed them with these: but even if they had earlier knowledge it could be of no use to others, since they wanted the common means of communicating their thoughts.

There is indeed no appearance of their having known any thing of astronomy even in its rudest state, before they became acquainted with the Greeks; but as soon as they were so, they adopted this among the other sciences, and studied it to great advantage. There are pretences of names among them that are said to have been given to certain stars from their earliest time, and transmitted from father to son among them throughout a thousand generations. But there is nothing to support this, and there is improbability in the very assertion. Nor are we to regard that some of their own writers affirm this, for it must be granted that, of all mankind that have made any pretensions to knowledge, the Arabians are the most ignorant of their own affairs. The earliest writer in astronomy, among them, is Suphi, and he lived but between seven and eight hundred years ago, and far from speaking of any early writers of his own country in the same science, he quotes the Greeks.

It will appear evidently enough then that the Arabian astronomy has nothing of that claim, that is pretended, to an antiquity earlier than that of the Greek, but that it was from this people they received it. Notwithstanding, however, that they received it from these, the many alterations, additions, and improvements, which they made in it, very well intitle the science, as professed and taught among them, to the peculiar name of their astronomy: and this the more as a great deal of what they added to the science has not been received, nor practised any where else.

To conceive the alterations they made in astronomy, we are first to look up to the constellations themselves. These they received from the Greeks, as that people had before received them from the Egyptians, and they were as much inclined as they had been to keep them sacred and unaltered; but this became impossible. Many of the constellations had the forms of men and women. What the Egyptians meant, who devised these, is uncertain, but the Greeks retained them as they were; only giving to them new names that they might seem of their own origin. The Arabs seem, by their conduct with respect to the rest, to have been as well inclined as the Greeks to keep these as they found them, but it was impossible. Their law forbad them on any occasion whatsoever to draw the figure of an human creature, and consequently, so many of them as they found in this form, they were obliged to alter, and we see how they have done it; they have placed very different forms in their places, but yet such as had some allusion to the figure, the posture, or the nature of the original ones. Hence arose a number of new constellations, which, being found in no books but in those of the Arabs, and in all those, are properly a part of the Arabian, or Arabic astronomy.

In the place of Aquarius we find in them the figure of a mule with a kind of saddle upon his back, and carrying two barrels of water. In the place of Gemini they have put two peacocks. This may serve to shew us, that they had no other knowledge of the Egyptian astronomy than what they received from the Greeks, for if they had known more, when they found it necessary to displace the Castor and Pollux of the Greeks, they would not have made another innovation by placing these two birds in their stead, but would have put the original two kids there. The sign

Virgo they were obliged to alter on the ſame occaſion, and they have put in the place of it a wheat-ſheaf. In the place of the Centaur, for though but half an human figure, they would not admit it as it was, they have put an horſe and a bear fighting. In the place of Auriga they have alſo put a mule, but it is unloaded; it has a ſaddle upon its back indeed, and the bridle is ſo diſpoſed as to have ſome ſtars in it, which is a conſiderable variation, for in the bridle in the hand of the conſtellation, as uſually drawn, there are none. In the place of Ophiucus they put a crane, a bird famous for deſtroying ſerpents, becauſe the human figure, which they dared not to draw, was in the act of deſtroying a ſerpent. Hercules, who is repreſented kneeling, is put out of the ſphere, but, that they may have ſomething that kneels, if they cannot have a man, they have put a camel in the place with his equipage on and kneeling, as that creature will do to receive his burthen. Sagittary's place is ſupplied by a quiver of arrows that they may keep up the remembrance of the archer by his inſtruments. Inſtead of Caſſiopeia they preſerve the chair, but place a dog in it. For Andromeda they give the figure of a ſea-calf; and, in the place of Cepheus, a dog.

Here then was a great alteration in the ſcheme of the heavens, which was not made out of whim or fancy, but from neceſſity: and in this we ſee ſomething that is properly called a part of the Arabian aſtronomy, ſince it has nothing to do with the aſtronomy of any other people. But this is not all. Beſide this alteration of figures in the heavens, the Arabs added ſome, and they added a great many names where they did not add any figures. It is not to be underſtood by this, that the Arabs added conſtellations, for if that were the caſe, we ſhould not have been certain about their falſe claim to antiquity, ſince thoſe figures might be prior to the Greek or Egyptian conſtellations, being received among them; but they gave peculiar forms for the arrangement of certain cluſters of ſtars which were in the larger conſtellations, and they gave names alſo to many other cluſters of ſtars, and alſo to many ſingle ſtars which were already in the other conſtellations.

Some very learned writers have been of opinion, that all the names of particular ſtars, and that the arrangements of thoſe ſeveral cluſters of ſtars which are in the larger conſtellations, were of Arabic origin, and that they were older than the Greek: that whatever the Greeks have taken of theſe, they took from the books of the Arabs, and that the reſt they never heard of. But this, although countenanced by Dr. Hyde, one of the moſt ingenious and learned writers we have had on this ſubject, is an overſight and an error. The Pleiades is one of the leſſer conſtellations or arrangements of ſtars within a larger conſtellation; and we find the Pleiades mentioned in Homer, Heſiod, and the oldeſt of the Greeks; men who wrote a vaſt many ages before there were any ſuch thing as books among the Arabs, and before even the uſe of writing among that people.

Although the Greeks did not take theſe names from the Arabs, the Arabs, as in the other parts of the ſcience, took them from the Greeks, and having taken only a few they added to them almoſt innumerably. The particular ſcheme and ſyſtem of their aſtronomy gave them occaſion to add to theſe, and they did it without end or meaſure. So that if we look into any one of the conſiderable conſtellations, we ſhall find a number of the ſtars, whether ſingle or in little cluſters, named from ſome fancied reſemblance of figure, from ſome poſition, or from ſome imaginary influence;

ence; and in ſome almoſt all the ſeveral ſtars are thus named. In Pegaſus, for inſtance, we ſhall find ſome of the conſiderable ſtars called and diſtinguiſhed by particular names taken from the parts of the figure in which they ſtand. One cluſter is called by a name expreſſing the neck of the horſe, another the ſaddle-place, and another the ſhoulder, another the loins or back; but when we have gone thus far according to the parts of the animal, we ſhall find ſingle ſtars, and cluſters of ſtars, in the remainder of the conſtellation, named more at random from influences and ſuch other doctrines; two are called Sad Mator, the meaning of which is, the fortune of rain; two others Sad Bois, the fortune of ſtorms; two others Sad Al homan, the fortune of the hero; two others Sad Al Bahaim, the fortune of beaſts; and ſo of others. And in Cancer, for inſtance, on the other part, we ſhall find a ſingle ſtar called Malaple, and two others Al Hamiran. The word Malaple ſignifies a manger, and the term Al Hamiran ſignifies the aſſes. Theſe are given to two parts of the conſtellation which the Greeks had before characteriſed by a ſingle ſtar in one part, and by two ſtars in the other, and had called the one by a word ſignifying a manger, and the other in a term ſignifying two aſſes. But it is evident, that, in a thouſand other places, they had themſelves been the inventors of the names and arrangements, ſince they have nothing to do with the Greek aſtronomy, nor are mentioned either by names of parallel ſenſe, or by any other names whatſoever among the Greeks, or were ever referred to in their writings, otherwiſe than as parts of this or that conſtellation which they deſcribed.

But having mentioned theſe arrangements of ſtars of the ſubordinate kind, and the names of particular ſtars, whether ſingle or in cluſters, as having ſomething to do with the Arabic aſtronomy, but nothing at all with the Greek, it may be proper to conclude theſe obſervations on the aſtronomy of that people by ſome notice of what was the great peculiarity of it, and the occaſion of theſe names; and of the innovations which they made in, and the additions they made to, that of the Greeks, whence come a multitude of the terms they uſe.

The lunar theory, as eſtabliſhed at this time, they were wholly unacquainted with, and yet they were not without a ſort of form of obſervation. They took notice of certain ſtars, or cluſters of ſtars, which the moon came in the way of every night, and even of certain parts of the heavens which that planet, in the ſame manner, came into every night, although there was no ſtar in them: for we find them giving names on this account not only to ſtars, and cluſters of ſtars, but to vacant places, for Alhelda is expreſly ſaid to have no ſtar in it. Thoſe ſeveral ſpaces, whether vacant, or beſet with ſtars, they called the houſes of the moon, and by whatſoever name they called the parts of the heaven, as ſuch, that became the name of the ſtar, or cluſter of ſtars, which were placed in it. Theſe gave occaſion to a great many of the names of the leſſer conſtellations, or of ſingle ſtars in the other conſtellations: and the doctrine of influences gave names to many more. They arranged all theſe parts of the heaven into one broad and large band, or circle, which they fancied in the heavens; this belt or band being divided into twenty-eight parts, and theſe anſwering to twenty-eight days of the lunation, they became able to ſpeak with ſome degree of propriety of the moon's place at certain times, and they could, for other purpoſes, mark the heliacal riſings of the ſeveral houſes, or parts of this great circle of the moon, as preſages, and for the ſake of their imaginary influences.

This

This is one of those things which is properly to be called a part of the Arabic astronomy, for it is what we meet withal only in their writings; and as the Greeks knew nothing of this, they could not have had occasion to name the several stars, or clusters of stars, that were conceived in these. The houses of the moon therefore are solely an Arab invention, and are a considerable part of the Arabian astronomy.

EASTERN HEMISPHERE. A term sometimes applied to a part or an half of the earth, as divided by a meridian, it therefore only expresses that part which is relatively east or west, under the consideration of that meridian: for the same country, may be in the eastern hemisphere with respect to one, and in the western hemisphere with respect to another meridian.

As the equator is a circle drawn round the earth at equal distance from the two poles, it divides the earth into two hemispheres, a northern and a southern; and these are fixed things. The line which divides the earth there being a fixed thing: in the same manner as this line divides the earth's surface into a northern and southern hemisphere, so does the meridian of any place, be it where it will, divide it into two hemispheres, an eastern and a western,. The meridian is a circle drawn through the two poles of the earth, and through the place of which it is said to be the meridian; this must therefore necessarily divide the earth into two halves, as the other divides it, but as this may be drawn through any part of the earth's surface, it may divide it in any manner with respect to the particular parts.

ECLIPSE. We meet with many pretences to calculations of eclipses very early in the astronomical times, but they will all be found idle and absurd on comparing them with the knowledge of the times, by which alone we ought to judge, or can determine of them. We are told, that, before astronomy was a science in Greece, the Chaldæans could calculate and foretel eclipses; but the same authors, who tell us this, tell us also that they could foretel earthquakes.

We are told, with much pomp, by the declaimers in favour of the Greek astronomy, that Thales foretold one: but there is too much against it to give us leave to pay it much credit; at least we are to understand it in a very different light from what the words would seem at first sight to make it. Thales had no tables that we know of, there is no account of any in his time, nor any reason to believe there were any, or, if there were, we cannot suppose them accurate enough for such a purpose as the calculating an eclipse. Herodotus is quoted for saying that he foretold one; but Herodotus, though a very honest writer, we full well know, is credulous. Beside, what does Herodotus say? not that Thales calculated an eclipse, as we should naturally.

To understand, and as others seem wilfully to have understood by the word, all that Herodotus affirms, is, that he foretold it within the compass of a year, and if he did this truly, it was a miracle for the time in which it was done. But there is so much uncertainty in the accounts, and such a disagreement in the opinions of authors about it, that very little stress can be laid on it. This is certain, eclipses were looked upon as portents and miracles after, even long after this, which would not have been the case, if men had known that they could be foretold.

One would imagine, from the accounts of eclipses quoted from the Egyptian annals by the oldest of the Greek writers, that astronomy had been much longer known in the world than it truly has been. The Egyptians are said to have kept records of between three and

four hundred eclipses of the sun, but we know how much they were addicted to fallacies, when they were speaking of any thing that might tend to make out the antiquity of their nation. That eclipses were incidents mentioned in the writings of the Chaldæans is certain, but then they were only set down as articles of history, and remarkable events of the period at which they happened. The Chaldæans were situated in a country very well calculated for astronomical observations, they had a great extent of the horizon open, and a clear air. Astronomy was in esteem among them, and they made, and they marked down, observations as they occurred; but it does not appear that they knew any thing of the laws and motions of the heavenly bodies farther than might be learned from immediate sight. There is no room to suppose that they understood enough of the lunar system to foretel an eclipse, or that they ever attempted it.

* ECLIPTIC. Is that great circle of the sphere about which the sun performs his annual revolution round the earth. This is supposed to be carried along the middle of the zodiac.

ELACATE. A name by which some, who are fond of uncommon words, have called the constellation Coma Berenices. The word signifies a distaff with the flax tied about it. This is no bad representation of the lock of hair as generally figured, and it is one of the names by which we find it mentioned in some of the late Greek writings.

ELASIPPUS. A name by which some, who love to write obscurely, have called the constellation Auriga; though an odd, it is not a new, name; it is one of the old Greek appellations.

* ELEVATION *of the Pole*. A term frequent in astronomical and in geographical writers, and denoting an observation of many and very considerable uses. The elevation of the pole of any place is the smallest measure from the horizon of that place of the pole, or the least distance of the pole from it. This is to be measured on the meridian of the place where the observation is made; and this elevation of the pole is equal to the latitude of that place from evident principles.

ELGIAZIAB. A strange name by which some have called the constellation Hercules. There is no language in the world to which this can be referred otherwise than by mistaken pronunciations. It seems a bad way of writing Giathi Ala Ruchbatichi, which is the Arab name of the constellation, and signifies a man on his knees.

ELHAD. A name by which those, who are fond of uncommon words, call the sun. It is one of the Syriac names of that luminary, and signifies alone.

ELIAS. A name which we find, by some authors, given to the planet Mercury. Schiller was the deviser of this term, and his followers only use it. This author set out upon the plan of what he called reforming the sphere. The first step was to new-model and new-name all the constellations, and, instead of allusions to the Grecian history, or fable, to make them refer to some part of the bible-history, or some article of the Christian religion. Thus he converted the twelve animals of the zodiac into the twelve Apostles, the Ram into St. Peter, the Bull to St. Andrew, and so of the rest. After this the other old constellations fell in his way, and he converted the Eridanus into the Red Sea, and the Hare into Gideon's Fleece, and so of the rest. After

ter these he took the new southern constellations into his consideration, and, after turning two or three of these into one of his scripture figures, and constituting his Job, his Eve, and the rest, to guard the south pole, he fell to work upon the planets.

Saturn he called by a new name, Adam; and Jupiter, Moses; Mars, with him, is Joshua; and Venus, St. John the Baptist; the sun, he calls Christ the Son of Righteousness, as he expresses it; and the moon, the Virgin Mary.

ELIAS's CHARIOT. A name given by some to one of the northern constellations, the Great Bear. There have been a set of writers who would refer every thing in the heavens to some part of the bible-history; these have called the two Bears, while they retained the form of those quadrupeds, the Bears of Elisha: when made wheel-carriages they make the great one the Chariot of Elias, and the lesser Jacob's Waggon, or the Chariot of Joseph. *See the article* URSA.

ELIAS's RAVEN. A name given by Schickard to the constellation Corvus.

ELLIPSIS. An oblong circle formed by the passing of a plane in an oblique direction through a cone. This is one of the figures called a conic section by astronomers. *See* CONE.

ELZAHARETH. A name by which some, who are fond of strange and sounding words, call the planet Venus. It is one of the Arabic names, and the word in that language properly signifies large or conspicuous, a very proper term for this planet.

ENGONASIN. One of the constellations of the antients, it is the same with that now called Hercules. Ptolemy mentions it under this name, and many at that time followed him.

EOOPHOROS. A name by which some have called the bright star Arcturus.

EOSPHORUS. A name by which many of the old astronomical writers mention the planet Venus, but they only call her by that name when she appears before sun-rise in the morning. The term signifies the bringer of the morning. They also called her Phosphorus, the bringer of light.

EQUAL, *in power*, *or* ÆQUIPOSSE. Quantities or numbers, which, being multiplied into themselves, produce equal squares and equal cubes, or equal second and third powers, are expressed by this term.

EQUAL PLANET. A name given by some of the astrological writers to Mercury. The denomination is founded upon an old tradition, and indeed is little other than a translation of the Stella Communis, a name by which it was called among the Latins. The people who look up to the planets for presages, beside allowing great force to their aspects, or mutual influence with certain constellations, allowed them certain inherent qualities, or powers of influences, well or ill. Thus Jupiter was naturally the planet of good fortune, and Saturn and Mars were the planets of ill fortune, but in a different degree, Saturn being esteemed more so than Mars: on the contrary, Mercury was supposed equal, or neither good or ill in himself, but determined only by his aspect.

EQUATOR. A great circle of the ſphere, placed at equal diſtance from the two poles. *See* CIRCLES *of the Sphere.*

To find the height of the equator, the familiar method is this. Provide an inſtrument fixed on the plane of the meridian, and with it take the meridian height of ſome one of the fixed ſtars which is in the equator, and conſequently has no declination: or, inſtead of a ſtar, take the moſt conſpicuous of the heavenly bodies, the ſun, and take his height at noon when he is in the equator; and this obſervation, whether made in the firſt way by a ſtar, or in the ſecond by the ſun, gives the height of the equator at one operation. But although this is the moſt familiar method, the thing is not limited to this, for the height of the equator may be found either by the meridian height of a ſtar which has declination, or by the meridian height of the ſun when it is not in the equator, only knowing firſt what is the declination of the ſtar from the equator, or how much the ſun's declination for the time of the obſervation. The obſervation being made on the ſun's meridian height at any time, the ſun's declination for that time is to be found; as by all this declination, he is lower than the equator, this quantity of his declination being added to his meridian height, gives the height of the equator.

The finding the height of the equator has this advantage, that the height of the pole is known as a conſequence, for the height of the pole is the compliment of the height of the equator. This, however, is not the readieſt way of finding the height of the pole: that is to be done as this other, by an immediate, and a very familiar obſervation; any of the ſtars that are within the arctic circle of the place ſerve for this purpoſe, and it is to be done either by a ſingle obſervation, or by the reſult of two. If it be done by a ſingle obſervation, ſome ſtar in the arctic circle is to be fixed upon, and its declination being firſt known, which is to be found in the table of declinations, the greateſt height, or the leaſt height of that ſtar, is to be obſerved; that is, its meridian altitude, or its altitude in that point, which is the loweſt of its apparent motion, which is its oppoſite meridian: for in theſe ſtars which are within the arctic circle, although in no others, the oppoſite meridian is to be ſeen. If the greateſt height of the ſtar be taken, the diſtance of the ſtar from the pole is to be abſtracted from it; and this gives the height of the pole in the remainder. If it were the leaſt height of the ſtar that was taken, the diſtance of the ſtar from the pole is to be added, and the whole gives the elevation of the pole for the place of the obſervation. If the two obſervations were made, and the ſtar's height was marked down at its meridian, and at its oppoſite meridian, then the middle between theſe two is the elevation of the pole of that place.

The only caution that is neceſſary in this reſpect is, that whether the greateſt and leaſt height of the ſtar, or only the leaſt height of it be taken for this purpoſe, the ſtar that is pitched upon for obſervation ſhould be one not near to the verge of the arctic circle, for, in this caſe, being near the horizon in the time of its leaſt height, the obſervation will be rendered uncertain from the refraction. It is not only that an error might ariſe from not obſerving the refraction, but that there will always be uncertainty in theſe obſervations from the variableneſs of that refraction.

In either of theſe methods the height of the pole being taken reciprocally, ſhews alſo the height of the equator in that place, ſo that the one being given the other is always known; for the height of the one of theſe is always the compliment of the height of the

 other.

other. But it is more safe to judge of that of the pole, from the observations of that of the equator, than conversely; for the height of the equator is taken by observations out of the way of error from refraction.

EQUINOCTIAL. A circle on the surface of the earth, answering to the circle called the equator in the heavens, and supposed formed by the plane of that circle passing through the centre of the earth. Those who live in the equinoctial have the days and nights of equal length throught the year. *See* CIRCLES.

EQUULEUS. A constellation in the northern hemisphere, mentioned by all the astronomical writers, and called also Equisectio, and the Horse's Head. It is one of the old forty-eight constellations, which are supposed to be of Egyptian origin, if not even older than the inhabitation of Egypt, and to have been taught by the Egyptians to the Greeks, who began about the time of Thales to travel into Egypt by way of improvement.

It is a small constellation; but it contains in proportion to its extent a tolerable quantity of stars. It is a very singular one in point of figure. It is represented in form of the head, and part of the neck of an horse, cut off as it were from the body, and its situation adds also to the singularity of its appearance, for it is placed just before the head of the horse Pegasus, whose figure makes another of the constellations in this part of the heavens; the bottom or section of the neck reaches to the front of the head of the horse, and extends from about its nose to its forehead. When the constellation Pegasus is viewed in the proper posture, this head, affixed as it were to his, has the appearance of that of another horse, urging forward on the opposite side of him, and just getting so far as by the head and neck before him.

Equuleus is at a considerable distance from the pole. The constellations near to it are the head of Pegasus on the one part, and the Dolphin on the other. The tail of the Fox is opposite to the opening of the mouth of Equuleus, but at a considerable distance. The section of the neck, as already observed, comes to the head of Pegasus, and the nose is opposite to the lower part of the body of the Dolphin.

The antients have mentioned only four stars in the Horse's Head, and strictly speaking in the head there are only four that are conspicuous; there are some smaller on the neck, and some small ones also besides these on the head. Ptolemy sets down four stars to this constellation, and we know he religiously followed Hipparchus. Tycho allows only the same number, but Hevelius raised it to six, and Flamstead discovered ten stars in it. The four principal of these, as already observed, are in the head, one is situated on the forehead, one at the eye, and two at the mouth, the three others, most considerable, are in a cluster in the neck. There is also a little one near the larger at the eye, and the rest are small. The largest of these are only of the fourth magnitude, the rest of the fifth and sixth, and principally of the latter.

EQUUS, *the Horse*. A name by which some of the astronomical writers have called the constellation more generally named Pegasus. Ptolemy has led them into this, but the more determinate term Pegasus is much more proper, as there is an Equuleus beside.

ERICHTHONIUS. A name by which many of the old astronomical writers have mentioned the constellation called Auriga.

The

The Greeks, willing to adapt ſome part of their fabulous hiſtory to a figure which they had received from their inſtructors, the Egyptians, called this by the name of that ſon of Vulcan, becauſe the bridle in his hand ſeemed a ſymbol of his invention of coaches. They knew not well what to make of the Goat and Kids in the figure, but they could not get rid of them, becauſe of a very conſpicuous ſtar in the conſtellation, one of the firſt magnitude, which was always underſtood and mentioned to be in the Goat's ſhoulder. They invented ſeveral other ſtories to adapt to this conſtellation, but all as idle. The Egyptians ſeem to have meant nothing by it but a countryman taking care of his flock of goats. *See* AURIGA.

* ERIDANUS, *the River*. A conſtellation of the northern hemiſphere, very conſiderable in its extent, and comprehending ſome ſtars that are ſufficiently conſpicuous. It is one of the forty-eight old conſtellations, and is named by all the writers on aſtronomy. Many of the figures of the conſtellations are unnatural enough. The Bears have long tails, and the Whale has legs, but the figure of a river is leſs liable to miſrepreſentation in the deſigning. It is repreſented in the ſchemes of the heavens as a river of conſiderable breadth, running in a crooked, not in a direct, courſe, turning, in one part, into a kind of ſemicircle. After this, it runs with various windings into the ſouthern hemiſphere, and continues its courſe to the foot of the Phœnix.

The conſtellations, about the part of the Eridanus which is in the northern hemiſphere, are Orion, the Bull, the Whale, the Dragon, and the Hare. In the ſouthern hemiſphere are the Phœnix, the Hydrus, and the Toucan. The conſtellation begins at the left foot of Orion. The ſtar of the firſt magnitude in that foot, which is alſo called by a particular name Regel, may be eſteemed the head of the Eridanus. It runs with ſome convolutions under Taurus, and has its great or ſemicircular bend juſt at the breaſt of the Whale, the legs and feet of that monſter among the conſtellations (for the Whale of the heavens has feet) come upon it. The Hare is oppoſite to another part of its courſe, and the Dog, but at a larger diſtance. It terminates at the Toucan, Hydrus, and Phœnix, which all ſtand near one another in the ſouthern hemiſphere; but it does not end there ſo determinately as it begins in the other.

The old aſtronomers allowed thirty-four ſtars to the conſtellation Eridanus. Ptolemy from Hipparchus ſets down ſo many, and all the others have followed him. Hevelius allows no more than twenty-ſeven, but Flamſtead raiſes the number to eighty-four. Of theſe there is not a ſingle ſtar either of the firſt or ſecond magnitude, but there are a conſiderable number of the third, ſome reckon twelve, others ten of theſe, but thoſe who diſpute a part, reducing them to the fourth claſs, yet allow eight or nine to be truly of the third magnitude, and there are enough in number to make a conſtellation very conſpicuous. One of the moſt conſpicuous of theſe is juſt before the breaſt of the Whale, and there are two others allowed on all hands to be of the third magnitude near to this. The reſt are, together with ſeveral ſufficiently bright ſtars, of the fourth and fifth magnitudes, diſtributed with tolerable regularity over the figure.

The Greeks, in their uſual manner of adapting ſome part of their hiſtory, or of the ſtory of their country, or of thoſe who had been the ſubjects of the exploits of their gods and heroes, have given the name of Eridanus to this conſtellation, which we find on all hands was in the earlier times called only by the general name of the River. It is likely that the figure

of one river is ſo like that of another, that there needed no peculiar legend to aſcertain the name; and yet there are ſome among their writers, who, inſtead of the Eridanus, call it the Euphrates, and ſay it is the river into which Venus and Cupid jumped for fear of the giant Typhon, and transformed themſelves (to avoid the danger) into thoſe two fiſhes, which were afterwards taken up into the ſkies, and made the ſign Piſces in the zodiac. Others, however, ſay, that the conſtellation repreſents the ſea in general, and was deſigned as a figure of it; and others, perhaps, with more propriety, that it is a picture of the Nile. Thoſe who tell us this, ſay alſo, that the ſingle large ſtar underneath it was once called Canopus, a name derived from that of an iſland in the Nile ſo called. All that we could know of it is, that it is a river, and that it very fortunately comprehends ſeveral ſtars.

Among the enthuſiaſtic writers on aſtronomy this conſtellation has obtained a couple of ſcripture names, but they have none of them altered its figure. Schickard only deſires that it may be called the brook Cedron, and Schiller that it may be the Red Sea over which the Iſraelites paſſed under the conduct of Moſes.

ERIGONE. A name by which ſome of the aſtronomical writers have diſtinguiſhed the ſign Virgo. Some, who would explain this, have ſuppoſed ſome queen, or great perſonage of the name of Erigone, to have been, for her peculiar virtues, exalted into the heavens; but a more probable ſolution is, that it was meant, like the conſtellation itſelf, to tell men of the time of harveſt. This conſtellation receives the ſun in Auguſt and September, when the ears of corn grow reddiſh, as promiſing harveſt. The word Erigone properly ſignifies red, and the virgin was intended only to repreſent ſome female labourer in the harveſt-work, by an ear of corn in her hand.

EVE. According to Schiller and his followers, a name of one of the ſouthern conſtellations. Theſe are a ſet of enthuſiaſts, who have, under the name of reforming the ſphere, new-modelled all the conſtellations; they have placed St. Peter in the place of the Ram, the Bull is converted into a St. Andrew, and ſo of the reſt of the zodiac. In regard to the old conſtellations they have uſually given one for one among their ſacred new ones; but when they got among the late-formed conſtellations of the ſouthern hemiſphere, they have generally taken two or three for one. Thus Eve is formed out of the ſtars, which, in the ordinary ſphere, compoſe the Bird of Paradiſe, the Chamelion, and the Flying Fiſh; and ſtands ſingly in the place of them all.

EXASTION. A name by which ſome have called that cluſter of ſtars in the conſtellation Taurus, commonly known by the name of the Pleiades, or, in Engliſh, the Seven Stars.

F.

F.

FERA, *the wild Beast*. A name by which some of the old astronomers call that constellation, now known by the more determinate name of Lupus, or the Wolf.

Schiller has transformed this constellation into one which he calls the patriarch Jacob, as out of the stars, which form the Centaur, he has made Abraham and Isaac.

FERETRUM, *the Bier*. A name by which, with the addition of the epithets Majus and Minus, some authors have expressed the Greater and the Lesser Bear. The Arabians began the custom. *See* URSA.

FIDICULA. A name by which some, who are fond of unusual words, have called the constellation Lyra. It is one of the old Latin names, but it is affectation to use such. Fidicula is also name by which the Latin astronomers have called the largest star in Lyra.

FISH. A name also given by some of the astronomical writers to the constellation Cetus, the Whale. A very considerable one in the northern hemisphere. *See* CETUS.

FISH, *flying*. A name given by the later astronomers to a constellation in the southern hemisphere, which some also call the Passer. It is a small constellation, and is situated between the root of the Royal Oak, and the body of the ship. *See the article* PISCIS VOLANS.

FISH SOUTHERN. A constellation of the southern hemisphere, placed at the feet of Aquarius, and swallowing the whole stream of water that comes from his urn.. It has the epithet Southern added to its name, to distinguish it from the constellation Pisces of the zodiac, for one of which figures it might else be mistaken. *See* PISCIS AUSTRALIS.

FLAMINGO. A name by which some call the new constellation of the southern hemisphere, more universally known by the name of the Crane, Grus. The Flamingo, called also the Flammant and Phœnicopterus is a tall bird, and they give its figure, instead of that of the Crane; but it is better to continue that of the more known fowl.

FLAMMANT. A name given by some, who are fond of new names, to a constellation in the southern hemisphere, commonly called the Crane, Grus. This Flammant is a name of the Phœnicopterus, or Flamingo, a tall bird, under whose out-lines some arrange the stars of the Crane, instead of using the figure of that more familiarly known bird.

FLUVIUS, *the River*. A name by which one of the constellations is called by some of the

the old writers; it is that which we characterise by the name of Eridanus. There was no impropriety in this at the time when they wrote, nor will there be any confusion about it when we know that they always mean the Eridanus by it; but it would be an occasion of perplexity to denominate the constellation simply the river now, because Royer has since exalted the Tigris into the skies; so that it is necessary to say now which river we mean, and to particularise this by the name Eridanus.

FLY. One of the constellations added to the forty-eight old ones by late astronomers, and situated in the southern hemisphere. It has its place between the feet of the Centaur and the head of the Chamelion, and it contains only four stars; it is called also the Bee. *See* Apis.

FOMAHAUT. A name by which many astronomers have called a bright star in the Fish's mouth; it is an Arabic name, it being a custom among the astronomers of that nation, as well as with the Greeks and Latins, frequently to call single stars by some peculiar name.

FORTUNA. A name by which some of the old astronomers have called the constellation Virgo. The head of this sign comprises only a few stars, and those not very large; they left all her head obscure, and attributed the whole figure to that diety of their imaginations, Fortune.

FORTUNA MAJOR. A name by which some of those authors, who affect uncommon expressions, call the planet Jupiter. It is founded on a very old opinion of this planet, being one of those that denoted prosperity. The Jews call it by a name expressing the star of good fortune, and the bridegroom, as a part of the marriage-ceremony, presented his wife with a ring, on which were the figure and name of this planet, as an emblem of good fortune and of fertility.

G.

GABRIEL. According to Schiller, one of the conſtellations of the northern hemiſphere: it is in the place of Pegaſus. This author has new-modelled all the conſtellations to make them repreſent holy hiſtories. Schickard has done ſomething of this, but he only converts the Horſe into one of the kings of Babylon, and Hartſdorf follows the ſame emendation.

GAD. A name by which ſome of the old aſtronomical writers have called Jupiter. It is ſuppoſed to be the name by which that planet was called among the old Jews.

GADIO. A name by which ſome have called the conſtellation Capricorn. It is the Syriac name for that ſign, and properly ſignifies a young goat or kid.

GALAXY. A name by which many have called the Via Lactea, or Milky Way in the heavens, a tract of a whitiſh colour and conſiderable breadth, which runs through a great compaſs in the heavens, ſometimes in a double, but the greateſt part of its courſe in a ſingle path or ſtream; and is compoſed of a vaſt number of ſtars too minute, or too remote from the earth to be ſeen by the naked eye, but diſcovered in great numbers in all parts of it by the teleſcope. There are ſome traces of the ſame kind of light about the ſouth pole, but they are ſmall in compariſon of this. Thoſe who have written on them call them luminous ſpaces and magellanic clouds, but they are, in reality, the ſame with the Milky Way.

GALLINA, *the Hen.* A name by which ſome aſtronomical writers have called that conſtellation which we at this time know by the name of the Swan. Ptolemy calls it the Bird, and ſome of thoſe who followed him have expreſſed themſelves in the ſame indeterminate manner. Others have appropriated the name to that of the Hen.

GALLINELLA. A name by which ſome of the Italian writers have called the Pleiades, or the Seven Stars. It is formed on an old cuſtom of calling them the Hen and Chickens.

GALLUS. A conſtellation formed by ſome authors out of the ſtars about the ſtern of the Ship, which they have thrown together under the figure of a cock: but the generality of writers continue to reckon them among the ſtars of the Ship.

GANYMEDE. A name by which ſome of the old aſtronomical writers have called the conſtellation Aquila. They ſay, in general, that this was the bird which Jupiter uſed in the carrying off that youth, and that he placed it

afterwards in the heavens; but some say Ganymede himself was changed into an eagle, and placed there. *For the disposition of the stars in this constellation, see* AQUILA.

Ganymede is also a name given by some of the old astronomers to the constellation Aquarius. They pretend that it is the figure of that youth exalted to the heavens. *See* AQUARIUS.

GARLAND. A name by which some of the astronomical writers have called the constellation more usually known by the name of Corona Borealis, or the Northern Crown. *See* CORONA.

GAVERO. A name by which some, who are fond of uncommon words, have called the constellation Orion. It is the Syriac name of that constellation, and signifies the Giant.

GEDI. A name by which some have called the constellation Capricorn. People, who are fond of uncustomary names, will ransack all the languages for them. This is the Hebrew name of that constellation.

GEMINI. One of the constellations of the northern hemisphere, and one of much consideration, being of the number of the twelve which mark the divisions of the zodiac, and from which the several parts of the ecliptic have been named. Gemini is plainly, on this account, one of the forty-eight old constellations, and it is mentioned by all the astronomical writers. It is the third in order of the signs of the zodiac following Aries and Taurus.

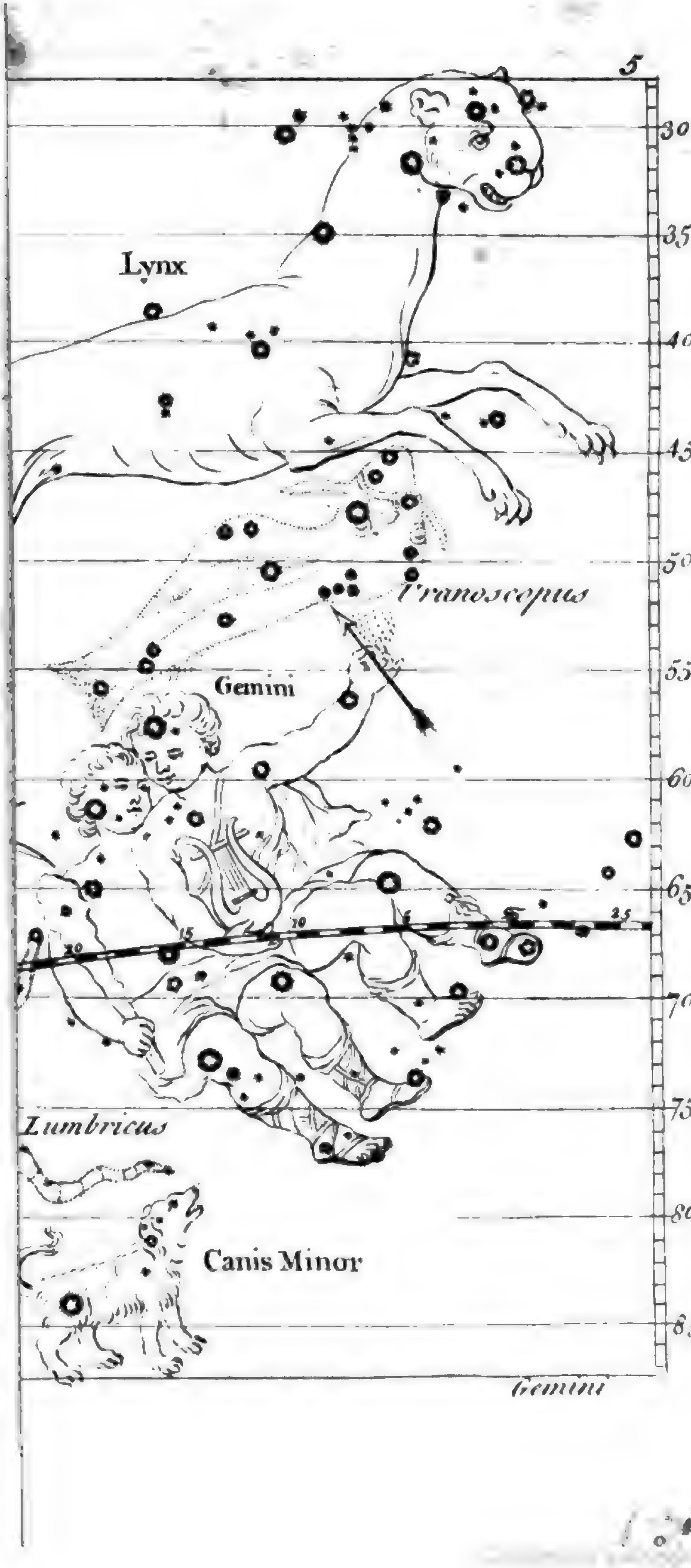
The Greeks, it is probable, received the figures of all the constellations from the Egyptians. That those of the zodiac were of this origin is yet more evident than that the others are so, and none more plainly than this. The Greeks had a vanity in boasting themselves to have been the inventors of what they received from this early people; and they had a custom of adapting part of their history to the signs in the heavens to countenance this pretence: but in this they often betrayed themselves, and they have particularly done so in this article, as will appear when we presently come to trace the origin of this figure.

Gemini is a constellation of some extent in the heavens, but it does not contain so great a number of stars as some others which occupy a smaller space; but then some of those contained in this figure are so conspicuous, and so advantageously placed, that the constellation is as easily determined on sight, as any in the heavens.

The figure, under which we see the constellation Gemini represented in the several schemes of the heavens, is that of two children, twins, placed close to one another, and represented as looking each other affectionately in the face. They have short hair, naked bodies, except for a little piece of a robe about the middle, and a kind of sandals upon their feet. The one holds in his right hand a club, his left is round the waist or hid behind the back of his brother; the other has in his right hand a lyre, and in the left a dart. The hand which holds this is extented.

The constellations, between which Gemini is placed, are Cancer, the Lynx, Auriga, Taurus, Orion, the Rhinoceros, and the Little Dog. Cancer is immediately behind them on the ecliptic, and Taurus before them; the back of the right hand figure is toward Cancer, and the face of the left toward Taurus. The Lynx is galloping over their heads, the hinder feet of that constellation coming near the Crab, and consequently near to the head of the right hand figure of Gemini. Auriga

is



5
30
35
40
45
50
55
60
65
70
75
80
85
Lynx
Uranoscopus
Gemini
25
20
15
10
5
Lumbricus
Canis Minor
Gemini

is near the right hand figure, his right knee comes toward the dart in its hand. The head of the Unicorn is juſt under their feet; the head of Orion juſt before that, and the whole conſtellation of the Little Dog juſt behind it. The ſpace that is between theſe ſeveral conſtellations is larger than can be filled up by this of Gemini, and conſequently there are many unformed ſtars left in it; but if a larger had been deviſed to take in a greater number of theſe, ſome of the moſt conſiderable could not have been ſo well determined.

The old writers allowed twenty-five ſtars to the conſtellation Gemini, there are ſo many ſet down to it by Ptolemy, and we know he was a ſtrict follower of Hipparchus, who, according to all hiſtory, made the firſt catalogue of the fixed ſtars that mankind ever ſaw. Tycho Brahe counted exactly the ſame number, but the ſucceeding aſtronomers were of a greater diſcernment. Hevelius diſcovered thirty-eight ſtars in Gemini, and Flamſtead eighty-five.

Of theſe there are ſome very conſiderable; there is one of the firſt magnitude in the forehead of the left hand figure, or Caſtor, for that is the uſual diſtinction. Some have called this only of the ſecond magnitude, but if not quite ſo large as Sirius is, it is bigger than all of the allowed ſeconds. There is one of the ſecond magnitude in the head alſo of the right hand figure, or Pollux. This is by all agreed to be of the ſecond magnitude, and it is much inferior to the other both in ſize and luſtre. There are five or ſix of the third magnitude, and they are very conſpicuous ſtars, one of them is in the left foot of Caſtor, another in the upper knee of the ſame figure, a third (but this is diſputed whether of the third or fourth magnitude) is in the fore arm of the ſame figure. A fourth is in the left knee of Pollux, a fifth in his left ſide toward the waiſt. From the ſituation of theſe ſeveral ſtars, which are the conſpicuous ones of the conſtellation, and thoſe, which the perſons who formed it were moſt deſirous to determine in a particular manner by their places, it appears very plainly, that they had reaſon not to enlarge the figure to fill up all the ſpace, for if ſo, theſe ſeveral ſtars could not have been allotted to places ſo eaſily determined when they are ſpoken of. The other ſtars in the conſtellation are, in general, of the ſmalleſt kinds, and they are diſperſed with a tolerable regularity over the whole figure, but there are, in general, more of them in the upper than in the lower part of it.

This figure of the conſtellation Gemini, repreſenting it under the form of two children, twins, has been received by all nations of the world except the Arabians, although it is not the figure that was originally adapted to that ſign, nor does convey any idea of the intent of thoſe who deviſed it. The Arabians have not departed from this through any knowledge of the error, nor have they come back to truth in the alteration. Their religion did not permit them to draw, on any occaſion, a repreſentation of human figures, and they were therefore obliged to alter all thoſe which had this original form in their delineations of the heavens. Thus they made a crane of Ophiucus, Auriga they debaſed into a mule, Hercules was made a camel, for Andromeda they put a ſea-calf, and in the place of Gemini, as repreſented by twin children, they put a pair of peacocks.

The Greeks, who have adapted ſome part of their fabulous hiſtory to every conſtellation, could not omit to claim the origin of ſo conſiderable a one as this, which was a zodiac ſign. They tell us, that the two figures repreſented in this conſtellation are the two brothers, Caſtor and Pollux, who make ſo great a figure in their hiſtory. The love and friendſhip of theſe heroes has been propoſed as a pat-

tern of affection to all succeeding brothers, and for this, as well as for their numerous exploits and deeds of heroism, they say Jupiter placed them in this conspicuous situation in the heavens.

The Greeks, however, are not so well agreed among themselves about the history of this constellation, as men usually will be who speak truth; for while the generality of their writers make the two figures, Castor and Pollux, some of note among them say they are Hercules and Apollo, and others Triptolemus and Jasion, the favourites of Ceres, who carried them to this place in the heavens.

This is the general account among the Greeks themselves. Sir Isaac Newton, who has been at great pains to ascertain the history of the constellations, refers them all to the time of the Argonautic expedition. He takes notice that Musæus, who is celebrated for having made the first sphere ever seen in Greece, was father to Orpheus, who was one of the Argonauts; and he adds, that the old constellations are designed to refer to certain incidents in that exploit, and that none of them have reference to any later. We do agree that none have, for their subjects or occasions, things that have passed since the time of the Argonautic expedition; but there is abundant proof that they are many of them, and probably they are all of them so, much earlier than that period, and that they are not the offspring of that people. It is evident, that, though we meet with continual mention of the constellation among the Greek astronomers, we are to look up much earlier for their origin.

Thales is allowed to be the first of the Greek astronomers who travelled into Egypt for the improvent of his knowledge, and great merit is laid to his conversations and familiarity with the priests of that nation, for they were the universal scholars. Thales died about five hundred and fifty years before the birth of Christ. Musæus, who, upon the credit of Laertius, is received as the maker of the first sphere among the Greeks, must have lived about seven hundred years earlier than that time, but by the little that was known, even by Thales, with the help of his Egyptian instructions, it does not appear that astronomy could have made any great progress at the time of Musæus. These, to which soever of them we would refer the rise of astronomy among the Greeks, are very late periods in respect to those from which we may trace it among that people, from whom the Grecians, in the time of Thales and his successors, confessed, and from whom it is probable, that they always had received the knowledge of the stars. It is to these people, or to their ancestors perhaps in another country, that we are to refer the origin of the constellations, for we shall find remains of their figures among them much earlier than the period of the Argonauts.

Although we are not willing to allow the full claim of the Egyptians of old any more than that of the Chinese at present to antiquity, for both nations carry their claim back into absurdity and folly, yet we must allow that they are a nation much more antient than any other of which we have any knowledge, and there are among them remains of acknowledged antiquity, in comparison of which all other things are modern. On these monuments of their earliest time which are covered with figures, which were the hieroglyphical writing of that people, there are found the forms of the constellations, and particularly of the several signs of the zodiac. The Crab and Goat are the most frequent, after these the Ram, the Bull, and Gemini, the Lion, and the others. It is certain, from the things about these, that they are meant to represent the signs in the heavens, not the animals

themselves as on the earth, and their order and disposition on some, the same in which they follow one another in the heavens, confirms it.

We are no longer then to look among the Greeks, an infant nation in comparison of these, for the origin of signs and figures, long before they became a people in use with these, and by their own accounts, so far as we have accounts of any thing on the occasion, borrowed from them. It is among the Egyptians then that we are to look for the origin of the constellations, and to come back to the point aimed to be explained here, how should any part of the Grecian story belong to the invention of the Egyptians many years before them; or what could those Egyptians, at that so much earlier period, know of the Castor and Pollux of the Greeks, born so many centuries after the invention of the constellation, in the figure of which they are pretended to be represented.

That Castor and Pollux could not be designed by the constellation Gemini then is evident, that on going yet farther back we shall find that no human figures at all were designed or represented in it. These old monuments shew us that not two children, but a pair of kids, was the original figure in this constellation, and the testimony they give, though in itself sufficient, is corroborated by the accounts of the earliest authors, who tell us, with one voice, that they were two young kids which the Egyptians placed in that part of the heavens. The observation was too plain not to have struck several who have considered it. Herodotus, who was well acquainted with the history of the times preceding his, so far as it was or could be known, tells us expresly, that the Egyptians knew nothing of Castor or of Pollux, and that it was impossible they should have heard even their names; and Hyde, in his treatise on the religion of the Persians observes, that the eastern people could know nothing of those two heroes, whom the Greeks had honoured with the place of the third sign of the zodiac.

Thus far then we are led with ease. The Greeks did not devise the constellations, nor has their fabulous history, one part or other of which they have adapted to every figure in the heavens, any relation to them. The Egyptians invented them, or they brought them from some other place where they had been invented, and this invention was so early that it preceded the fabulous history of this vain people, and having been made in the simpler ages of the world, had doubtless more simplicity, and more respect to use, than pomp and ostentation. Macrobius has very judiciously explained the origin and the intent of the invention of the constellations in his account of Cancer and Capricorn; and Pluche has followed the plan. This venerable antient refers the figures to some meaning and expression, and making them a part of the hieroglyphic language of the people, among whom they were invented, he gives them appropriation and utility, and places their origin in reason. A Pollux, or an Hercules, might be as well placed in one part of the heavens as in another, and the placing them any where would answer no purpose, but that of an idle ostentation, whereas if we suppose a people who expressed themselves by hieroglyphics, formed of the figures of animals instead of words, selecting some or other of those animals on these particular occasions, we shall find instruction and utility in the assigning them their places, and the study of them will be like that of a language. Macrobius says, they placed the Crab and the Goat, Cancer and Capricorn, not by chance, or without claim, at the two barriers of the sun's course, but at once to mark the points, and so convey the knowledge of what happened at them.

When the ſun arrived at a certain part of the heavens, they perceived that he began to move backward, and to deſcend obliquely. To mark that ſpace or portion of the heavens, at which this happened, they were to take note of the ſtars which ſtood in it; and they were, for the ſake of ſpeaking of them familiarly, to arrange them under the form of ſome animal: they were accuſtomed to hieroglyphic writing, and they choſe for this purpoſe the figure of a Crab, a creature which moves obliquely, and backward, as the ſun then began to do. On the other hand, they were to mark, as the other barrier of his courſe, a part of the heavens, at which that luminary, having quitted the lower part of his courſe, began to riſe higher and higher. On the ſame plan, and with the ſame intent, they ſelected for the figure, under which to arrange theſe ſtars, that of a wild Goat, an animal which was always climbing up the mountains.

It is on this principle laid down by the happy thought of Macrobius, that we ſhall make out the meaning of all the reſt. The diviſion of the zodiac into conſtellations was very early, and the uſe of that diviſion was to point out to the huſbandman the ſeveral periods of buſineſs and of profit.

The ſpring was the time when the young lambs, and the reſt of the offspring of the ſtock, began to follow their mothers over the new covered fields, and gather ſtrength in the warm ſun, and from the freſh grown herbage. The great articles of this ſtock were the ſheep, the ox, and the goat, and theſe brought up their young ſucceſſively in the encreaſing warmth of the ſpring, and under favour of the farther growing of the paſturage: the lambs followed their dams along the fields in the earlieſt offer of good weather; a month after theſe the calf trotted along after its larger parent, and at a yet more advanced period, but ſtill within the limits of the ſpring, the Goat, followed by her double litter, cloſed the encreaſe. It was the great point of the huſbandman's buſineſs to know when all this was to happen, and it was of importance to him to have notice of the approach of the glad ſeaſon, and to prepare for it. It was ſoon ſeen, that the progreſs of the ſun along the ſeveral parts of the heavens occaſioned this, and it was with intent to know exactly when this effect ſhould be produced, that they remarked theſe ſeveral places. They were to aſcertain the ſtars that occupied each ſpace, or part of his courſe at this time under the figures of animals, any animals would ſerve the purpoſe, and which ſhould they chuſe ſo naturally, or indeed ſo properly, as thoſe very ſpecies, the care of which occaſioned the obſervation; they ſelected theſe, and they placed them in the order of time in which their young appear. The Ram, the father of the flock, was the conſtellation that marked, by the ſun's entrance into it, the firſt portion of the ſpring; the Bull the ſecond, and the third, the fruitful Goats encreaſe the twin kids, but not twin heroes, according to the fabulous Greek hiſtory.

As the origin of the conſtellations has on this occaſion of the ſingular and little underſtood ſign Gemini, been enquired into, it may not be amiſs to add a few words, by way of explanation, of that hint, given toward the beginning of this article, that Egypt, although the place whence the Greeks received the figures of the conſtellations, might not be that where they were firſt invented, and that thoſe who diffuſed them over the reſt of the world, might themſelves have brought them from elſe where. It is not only that they might, they certainly did bring them from ſome other, and that ſome very diſtant place. We have ſeen that theſe three figures of the con-

ſtellations,

ſtellations, which mark the ſeveral parts of the zodiac, or the twelve diviſions of the ecliptic, were deviſed to remind men of the ſeaſon for their ſeveral parts of huſbandry, and this will be eaſily proved with reſpect to all the reſt. Among theſe the conſtellation Virgo, which however raiſed into a kind of angel by the Greek painters, was in the original, and among the Egyptians, no other than a ſun-burnt maid, who wrought in the fields, holding in her hand an ear of reddening corn, betokened the approach of harveſt: this appears from the Egyptian figures of the higheſt antiquity. I ſhall mention only one more, Aquarius, the watery conſtellation, who ſeemed to pour the rains of winter out of his full urn, and was the ſign of foul weather. Theſe marked the ſeaſons of approaching harveſt and of winter, and it was with that intent the figures were placed in thoſe parts of the heavens; but although this anſwered very well to the ſucceſſion and nature of the ſeaſons in all other parts of the world, it by no means agreed with Egypt. Auguſt and September are indeed the times of approaching harveſt with us, and over all the world beſide almoſt, but not in Egypt. The harveſt there is in March and April. And as to Aquarius, who very well marks the rain and bad weather to us, and to the reſt of the world, in this alſo Egypt is particular, and has nothing to do with the prognoſtication; for in Egypt it never rains, and the winter is the fineſt ſeaſon of the year.

It follows then, that the conſtellations which mark the ſeveral diviſions of the zodiac, although they were brought from Egypt into all the other parts of the world, yet were not invented in Egypt. There is great reaſon to believe, that the obſervation of the heavens was very early, probably it had its origin in that country, where all mankind lived together immediately after the flood, and that the Egyptians carried the obſervations with them to the borders of the Nile when they went to ſettle there; and although the figures of the conſtellations no longer conveyed the meaning that was intended by them, and which is anſwered to all other people, they continued the uſe of them to prevent the confuſion that might have ariſen from innovation.

The antients attributed to every ſign of the zodiac one of the principal deities for its tutelary power. Phœbus had the care of Gemini, and thence all the jargon of aſtrologers about the agreement of the ſun, and this conſtellation.

GENASH. A name by which ſome, who are fond of hard words, have called the conſtellation Urſa Minor. It is the Hebrew name of that conſtellation.

GEOGRAPHICAL MERIDIAN. A term that is uſed by aſtronomers to expreſs what is properly only the half of a meridian circle. A meridian, when the term is underſtood at large, is a great circle of the earth, drawn through both the poles of the earth, and through the place whoſe meridian it is. In this caſe the two poles of the earth divide this circle into two equal halves, or ſemicircles, the one of which paſſes through the place whoſe meridian it is ſaid to be, and the other through the point of the earth that is exactly oppoſite to that place. Now as the ſemicircle which paſſes through the place is often referred to without any connection with the other ſemicircle, it is, in this caſe, called ſometimes the geographical meridian, or ſometimes only ſimply the meridian. The other being called the oppoſite meridian. All thoſe places which lie ſo that this ſemicircle,

called the geographical meridian, paſſes thro' them, are called places under the ſame meridian.

GERGNUS. A name by which ſome affect to call one of the new formed conſtellations of the ſouthern hemiſphere the Crane. It is a Greek name of that bird; but it is a ſtrange folly to adapt that to a conſtellation, of which the Greeks had no knowledge.

GHAU. A name by which ſome call the conſtellation Taurus. It is the Perſian name of that ſign.

GHEZDUM. A name by which ſome, who are fond of hard words, have called the conſtellation Scorpio. It is the Perſian name for that conſtellation.

GHIRDEGAN. A name by which ſome aſtronomers, or more properly ſpeaking ſome aſtrologers, have called the conſtellation Gemini. It is the Perſian name of the ſign.

GIATHI ALA RUCHBATECHI. A term by which ſome, who are fond of uncommon words, have called the conſtellation Hercules. It is a ſounding name, and is that by which the Arabs call the ſame conſtellation; but it means nothing more than a man on his knees.

GIAUZA. A name by which ſome have called the conſtellation Gemini. It is one of the Arabic names of that conſtellation; but the more uſual name in that language is Taua-amân.

GIDEON's FLEECE. A name, according to ſome writers, of one of the conſtellations. Schiller has been the deviſer of this. He has arranged under this form the ſtars which compoſe the Hare of the old aſtronomers, at the foot of the conſtellation Orion.

GIEDI, *or* AL GJEDO. A name by which ſome writers, fond of hard words, have called the ſign Capricorn. It is the Arabic name, and ſignifies a kid.

GIEDYAN. A name by which ſome have called the two bright ſtars in the arm of Auriga; the Arabs gave them this name. They are the famous Hædi, ſo often mentioned in the old Greek and Roman poets, as the cauſes of ſtorms and tempeſts.

GIGAS, *the Giant*. A name that we meet with in ſome of the old aſtronomers, as belonging to one of the antient conſtellations. There having been diviſions about its meaning, all that can be aſcertained among the old authors is, that it is the ſame with the conſtellation, called Al Gabbar by the Arabians; but as this is not well determined among thoſe writers, and as the ſignification of the word is no more than Gigas, a Giant, nothing more is to be collected from it, than that this and the other are the ſame. It was natural on the reading of a Giant, as a conſtellation, to caſt up the eyes toward the great human figures which there are in the heavens, ſince the Arabs having learned their aſtronomy from the Egyptians, and thoſe conſtellations having been all formed by that people, it muſt be ſome one among theſe. The moſt natural conjecture was, that it was that figure which, being kneeling on one leg, the Greeks had called Engonaſin, and afterwards Hercules; ſome have diſputed this, and ſuppoſed it Ophiucus, whom others have aſſerted to be Hercules alſo, only under another name; but it is much more probable, that it is Orion than

than that it is either of theſe; we do not well know by what names the Egyptians called the conſtellations; but it is lucky that in this we find the oriental word Chimah preſerved as its name. Now Chimah ſignifies, as Al Gabbar does, a Giant; and as that conſtellation, which the Greeks, out of a vanity of being ſuppoſed the inventors of aſtronomy, called Orion, was, as we thus find, called ſimply a Giant by the real inventors of it; it is not to be doubted, but that it is the conſtellation called Al Gabbar by the Arabians, and Gigas by ſome of the old Latins.

The name of this conſtellation Chimah, with another word Cheſil, the name of another conſtellation, occurs twice in the book of Job, and alſo in Iſaiah and Amos, as the names of certain arrangements of ſtars, and theſe words the Greek verſion renders by Orion and the Pleiades. Unluckily they have fixed Cheſil for Orion, and they have made Chimah the Pleiades, but all was gueſs work in this reſpect, and the wonder is that they came ſo near the truth.

GLOBE. Nothing is more frequent in calculation than the demand of what is the ſuperficial content of a globe, the diameter or the circumference of which is given. In order to determine this, we are firſt to find the area of a great circle of the globe which we know to be as little more than three to one to its diameter. This is explained under the article CIRCLE. When this is found, we are to multiply that area by the number four, and the product of this is the ſuperficial content required. When the ſuperficial content of the globe is thus found, it is eaſy from it to find the ſolid, or the whole content. In order to this the number expreſſing the ſuperficial content is to be multiplied by a ſixth part of the diameter of the globe, and the product is the ſolid content required.

GLOBE, *Celeſtial.* A ſphere of wood, or any other materials, intended to repreſent to the eye the outer or convex ſurface, of what we call the ſphere of the heavens, as it is imagined it would be ſeen by a perſon placed at an immenſe diſtance from it in the void of ſpace. On this are drawn a number of circles to repreſent thoſe which aſtronomers imagine to be drawn in the heavens themſelves. Theſe are ſometimes alſo repreſented for the ſame purpoſes upon what is called an hollow ſphere. This is formed of braſs-hoops, or rings, placed in the ſituation of theſe imaginary circles, and the interſtices void. *See* SPHERE.

GLOBE, *terreſtial.* A ſphere of wood, or other materials, on the convex ſurface of which are marked out the earth and ſea of the globe we inhabit, the mountains, plains, and extent of kingdoms; and beſide theſe real objects, certain imaginary lines and circles, ſerving the purpoſes of the geometricians, and which they imagine drawn upon the ſurface of the earth itſelf. *See* SPHERE.

GOAT, *Capricorn.* One of the conſtellations of the northern hemiſphere, and one of the twelve ſigns of the zodiac. *See the article* CAPRICORN.

GOAT. A large ſtar in Auriga, near the ſhoulder. It is called the Amalthæan Goat, and the mother of the kids; and is often named in the Latin poets under the name of Capra.

GAIND DAY. A term uſed by aſtronomers to explain what may ſeem a ſtrange paradox to thoſe who are not acquainted with the doctrine of meridians, that is, the twenty-four hours, or ſpace of a day and night, which would

would be loſt by the perſon who ſhould take the whole circle of the globe in a journey made weſtward by that time he returned to the place from whence he ſet out, or came to any place under the ſame meridian. The term Loſt Day expreſſes the twenty-fours loſt by making the ſame journey eaſtward, and under that article it is explained.

GOOSE AMERICAN. An Engliſh name for one of the new ſouthern conſtellations, called, by the original deſigners of it, the Toucan. It is ſituated between the Phœnix and the Indian, and the figure is that of a bird with a very large beak. The drawing is near enough to nature, and the Engliſh name has been given by ſome who were very badly qualified for that office. The Toucan is a Braſilian bird, remarkable for its enormous beak, it is indeed almoſt a genus by itſelf, and referable to none of the known kinds of fowl among us. Thoſe, who ſpeak of it before it had a peculiar generical name given to it, and comprehending two or three others like it, called it not the American Gooſe, but the American Magpie, or the Braſilian Magpie.

GORAB. A name by which ſome, who are fond of uncommon words, call the conſtellation Corvus; it is the Arabic name of it. They call it alſo Algorab, that is, the Raven.

GORGONIUS. A name by which ſome call the conſtellation Pegaſus. It is one of its old Roman names, and we meet with it in Pliny and others.

GRADIVUS. A name which people, who are fond of uncommon words, have given to the planet Mars. It was one of the old appellations of the deity of the ſame name.

GREYHOUNDS. A name of one of the new conſtellations of the northern hemiſphere, deſigned out of the unformed ſtars of the antient ſcheme, and added to the forty-eight old conſtellations. The Greyhounds, or Hounds, for they are called by either name, are diſtinguiſhed under the denominations of Aſterion and Chara. They are in the hands of Bootes, and ſeem barking after the Great Bear. *See the article* Canes Venatici.

GRUS, *the Crane*. One of the new conſtellations of the ſouthern hemiſphere; it is but a ſmall one, and the quantity of ſtars which it contains is not even proportioned to the ſpace it occupies in the heavens. It is repreſented by the figure of a crane ſtanding erect, with the head turned to one ſide, and the wings extended. As they uſually draw it indeed it ſeems rather a bird ſtuffed in a collection, than any thing living.

The conſtellations, between and among which this of the Crane is placed, are the Phœnix, the Southern Fiſh, and the Toucan. The Phœnix is juſt at its ſide; the left wing of that bird touches the right wing of the Crane. The tail of the fiſh is at a ſmall diſtance from the head of this conſtellation, its left wing is at a ſmall diſtance from the arrows of the Indian, and the head of the Toucan comes very near to its left leg.

The ſtars allowed to this conſtellation are thirteen, and they are ſo diſtributed that the figure is eaſily known in the heavens. There is one in the middle of the head at the place of the eye. There are two in the neck, one at the beginning of the breaſt, one large and conſpicuous one in the middle of the breaſt, and another nearly parallel to it. In the left wing there are two others ſmaller than theſe, but conſpicuous enough, and two or three others in the lower

part of the body toward the left thigh; these are what mark the constellation, and they did it with a sufficient accuracy.

Grus is also one of the Arabian constellations; it answers to our Ophiucus. They were not permitted to draw human figures on any occasion, their religion forbad it, so they were forced into these alterations.

* GRYPHITES. A constellation offered to the astronomical world, and formed out of certain conspicuous stars near the sign Hercules in the northern hemisphere. It is a small constellation, but for its extent very well set with stars.

The Gryphites, from which it obtains its name, and under the out-lines of whose figure the stars very happily fall, is a species of shell-fish, the remains of which are very frequent in beds of stone, and at depths in the earth, but which, in its recent state, is an inhabitant of the deep seas only, and scarce ever is washed on shore: it is of the oyster kind, but has a figure approaching to the Nautilus. Most of the writers on natural history have mentioned it, and it is described and figured in the history of fossils.

Its figure and place in the heavens will be seen in the same plate with Hercules; it is situated between that constellation and those of Lyra, Vulpis et Anser, Aquila, and the Serpens Ophiuci. It is placed in an inverted posture with respect to Hercules, and is at a small distance over his left arm; the horns of the Lyra are at some distance over the head of the Shell, it is in a line with the Fox and Goose, and the head of it stands opposite to the wing of the Goose. The tail of the Eagle comes also toward its head, and the sweep of the lower part, or back of the shell, is over the tail of Ophiucus's Serpent, and in part over the head of Ophiucus. The upper part or hollow of the shell is opposite to the lower part of the arm of Hercules, his hand is against its middle, and the lip, or turning-up of the shell, is opposite to his shoulder.

The Gryphites consists principally of eleven stars, and these almost all very conspicuous; they are so well disposed also in the figure, that there is not a constellation in the heavens better marked, or more easily distinguished. They are situated principally toward the head and toward the lip of the shell, in the middle there is a vacancy, there is one in the head, and another a little below it; beyond this, toward the body, there are two, one of them near the upper, and the other near the under out-line of the shell, and a little above and beyond that of the upper out-line there is a fifth smaller than any of the others, but sufficiently conspicuous. Toward the extremity there are two in the lower part near one another, and very conspicuous. Beyond these, where the shell turns up, there are three others, one near the lower, one near the upper out-line, and a larger and more conspicuous than either a little beyond and between them. This tenth star is the largest in the whole constellation. The eleventh and last is a small, but very bright one, placed at the verge of the lip. The whole constellation is as bright a cluster of stars as any in the heavens.

GUAD. A name by which some, who are fond of uncommon terms, call the constellation Eridanus. It is a Moorish name, and signifies only the river.

GYHON. A name by which some, who are fond of uncommon words, have called the constellation Eridanus. We find it used by some, but not by many, of the old writers.

H.

HAGJILER ULI. A name which ſome, who are fond of uncommon and hard words, have called the Via Lactea, or Milky Way in the heavens. It is the Turkiſh name, and ſignifies in that language the road of the joyful. They alſo call it by another name, ſignifying the way of ſtraw. Names of this laſt ſignification are given to it in all the eaſtern countries from the Egyptian fable of Iſis's ſtraw.

HAJAH. A name by which ſome of the aſtrologers have called the conſtellation Draco; it is one of the Hebrew names, and ſignifies a ſerpent; but its more uſual name in that language is Nabaſh Barih, the meaning of which is the Crooked Serpent; it is by this name that it is mentioned in the book of Job, when the Almighty is ſaid to have formed it.

HAIJER. A name by which ſome have called the conſtellation Draco, near the north pole; it is one of the Arabic names of that conſtellation; but it is liable to ſome uncertainty in the interpretation, ſince they ſometimes expreſs by the ſame word the conſtellation Hydrus of the ſouthern hemiſphere. The word ſignifies a ſerpent.

HAIR *of a Comet*. When the tail of a comet is viſible only in form of a circle of light, round about the whole circumference of the ſtar, inſtead of being drawn one way in length behind, it is called the Hair of a comet; as when it is before, and not behind the body, it is called, not the tail, but the beard. This is all the real diſtinction between the tailed, the bearded, and the hairy comets. When the comet is in oppoſition to the ſun, the earth being between them, the tail is, with reſpect to the earth, thrown quite ſtrait behind the body, and can only be ſeen as forming a border of light round its verge, by being of a breadth too great to be wholly obſcured by the body of the comet.

HAIYA, *or* AL HAYRO. A name by which ſome, who are fond of hard words, call the conſtellation Serpentarius; it is properly indeed the name of only the Serpent; for it is an Arabic word, and ſignifies a ſnake; they put it in the female gender to diſtinguiſh it from Draco.

HAMEL, *or* ALHAMAL. A name by which ſome of the old writers have called the conſtellation Aries, or the Ram; it is the Arabian name of that ſign. The aſtrologers have principally uſed it.

HAMIL. A name by which ſome, who love uncommon words, call the conſtellation Perſeus; it is a part only of the Arabic name of

of the ſame conſtellation. The whole name is Hamil Ras Al Ghul, and ſignifies carrying a fury's head, alluding to the Gorgons.

HAMMOSCLUSCH. A name by which ſome, who are fond of hard names, have called the Triangle; it is the Hebrew name of the conſtellation, and ſignifies a Triangle.

HANCE, *or* AL HANCE. A name by which ſome, who are fond of uncommon words, have called the conſtellation of the Arrow; but it is a corrupt word. They intend it as the Arabic name of that ſign, but that properly ſpelt is Al Tahin.

HAUD. A name by which ſome, who love uncommon words, have called the conſtellation Coma Berenices; it is made out of the Arabic name of that ſign. The writers of that language call it Alhaud, a word which ſignifies a ſtream, or fountain of water; this may poſſibly be ſuppoſed to be in ſome manner repreſented by the figure.

HANGUE, *or* ALHANGUE. A name by which ſome of the writers of aſtronomy, who are fond of obſcure terms, have called the conſtellation Serpentary; it is one of the Arabic names of that conſtellation; and ſeems derived from the Turkiſh name Yilange, or Alyilange, which, in that language, ſignifies a man combating a ſerpent, the ſame as Serpentarius.

HAPLETURENGH MEHEN. A name by which ſome, who are fond of ſtrange words, call the conſtellation Urſa Major, or the Great Bear; it is the Perſian name of that conſtellation.

HARE. One of the conſtellations of the northern hemiſphere; it is one of the forty-eight old aſteriſms, and ſtands at the right foot of Orion. *See the article* LEPUS.

HARMELATES, *or* ARMELATES. A name by which ſome, who are fond of hard words, have called the conſtellation Auriga; it is one of the old Greek names of that conſtellation.

HARP. One of the conſtellations of the northern hemiſphere. The antients counted only ten ſtars in it, but the moderns have diſcovered twenty-one; one of theſe is of the firſt magnitude, and is called Lucida Lyræ. The conſtellation is before the figure of the kneeling Hercules. *For an account of its compoſition and origin, ſee the article* LYRA.

HASUS CHAIL REZMIN. A ſtrange name by which ſome have called Pegaſus, or the Greater Horſe; it is the Hebrew name of that conſtellation, and it ſignifies not a winged horſe, as this is painted upon our globes, but a horned horſe.

HAUT, *or* AL HAUT. A name by which ſome, who are fond of unuſual terms, have called the conſtellation Piſces; it is the Arabic name of the ſign, and ſignifies fiſh.

HAUWA, *or* AL HAUWA. A name by which ſome, who are fond of hard words, have called the conſtellation Serpentarius, or Ophiucus; it is one of the Arabic names, and ſignifies one who keeps or nouriſhes ſerpents. Some ſuch idea they conceived from the figure of a man, with a ſerpent between his legs, and in his hands; but certainly he is killing it.

HAWITE. A name by which ſome, who

 are

are fond of uncommon words, call the conſtellation Draco; it is one of its Arabic names, and it ſignifies in that language a ſerpent.

HEAD *of a Comet*. This is the term uſed by ſome aſtronomical writers to expreſs what is properly the body of the comet, or in diſtinct words, the comet, including all but its tail. Others uſe the word body of the comet, or Neucleus of the comet, in the ſame ſenſe.

HEAVENS. The ſpace extended every way above our heads in which the ſtars are placed. The antients had very faint and confuſed ideas of what this was; but ſince the invention of teleſcopes, which is about an hundred and fifty years, we have become better acquainted with this ſpace, and are able to examine the ſeveral bodies that are fixed immoveably in the ſeveral parts, or revolve round about one another in them. It is by means of theſe inſtruments, more than all others, that we have been led onwards in our advances towards the perfect knowledge of thoſe bodies, and that aſtronomy has been improved from little more than a catalogue of obſervations into a ſcience; it is therefore of the heavens, as teleſcopes ſhew them to us, that we ſhall ſpeak in this place.

It was but by ſlow degrees that men became acquainted with what truly paſſed in this vaſt ſpace; but they no ſooner ſaw, than they began to enquire into the cauſes of what was ſeen there, and their ſeveral ſyſtems as they were founded upon, ſo they were proportioned to the truth, and the extent of their diſcoveries. Plato and Ariſtotle ſuppoſed the heavens ſolid, although tranſparent, and ſuppoſed the blue ſpace extended over our heads firm as a ſapphire. They placed the earth in the centre of the univerſe, and ſuppoſed it to be wholly at reſt, while they divided that ſpace into ſeveral diſtinct heavens, but all of the ſame firmneſs and ſolidity.

Ptolemy diſcountenanced this ſyſtem. He ſays, that the deities, that is the name by which he calls the ſtars (for they were adored in his time) moved in an etherial fluid. Notwithſtanding the many errors in the ſyſtem which he gives us, (for the ſole principle of his placing the earth in the centre, muſt make way for a thouſand) we cannot but admire the addreſs, by which, although ignorant of the truth, he, in ſome way, explained the apparent motions of the heavenly bodies, and framed a ſyſtem, which brought them into the reach of calculation.

The ſucceeding aſtronomers agreed in his doctrine of the nature of the heavens, and we are at this time ſenſible that the ſpace which is called by that name is ſupplied only with æther, or with a fluid, more fine and ſubtile than air itſelf. Moſt of the ſucceeding writers on the ſubject agreed with him alſo that the planets rolled round about the ſun; but it was not till about two hundred years ago that Copernicus revived the ſyſtem of the old Pythagoras, and aſſerted, that the ſun was placed in the centre of the univerſe, and that the earth, as well as all the other planets, performed a revolution round it. What Copernicus thus eſtabliſhed, all the ſucceeding aſtronomers and philoſophers countenanced till the days of Sir Iſaac Newton, who, from the obſervations he made, and the laws he delivered concerning the whole ſyſtem of the univerſe, proved and ſupported it in ſuch a manner, that it will never be overthrown. Men believed before that it was truth; but they are now aſſured of it: what was but probable conjecture, is perfect certainty; and there will be no more doubts about it ſo long as the world itſelf holds together. The ſeveral parts of this ſyſtem will be explained under their proper

per heads in this work; but here we are only to give a ſummary account of what we underſtand by that which they call the heavens.

The heavens then, to follow the path of this true ſyſtem, are of an indefinite extent, they are filled with a fluid much finer and thinner than this air, and extending beyond all limits, of which we have any conceptions. There being nothing viſible to us in the remote part of the heavens, we can only conſider them as the places of the ſtars. All the fixed ſtars are ſituated in them, and although they ſeem ſo near to one another in our view of them, they are doubtleſs at an immenſe diſtance each from the other, and at a very different diſtance with reſpect to us. We ſhall have a vaſt idea of this ſpace if we conſider that the largeſt of the fixed ſtars, which are probably the neareſt to us, are at a diſtance too great for the expreſſion of all that we can conceive from figures, and for all means of admeaſurement; the ſmaller are doubtleſs more and more remote to the leaſt, or thoſe which are of the ſixth magnitude. Theſe muſt be in a part of the heavens vaſtly more remote from us than the others; and yet beyond theſe teleſcopes diſcover to us more ſtars, too diſtant to be at all perceptible to the naked eye; and as theſe inſtruments are more powerful, they diſcover yet more numerous ones. We may conceive by this, in ſome meaſure, what, and how great muſt be that extent, which admits of no known limits. Plato and Ariſtotle ſuppoſed the heavens terminated ſomewhere; but what muſt it be that is beyond them.

In that little ſpace of the heavens which makes the ſyſtem, of which our world is a part, the ſun occupies the centre. The ſun is in reality nothing more than a fixed ſtar, although from our being ſo near to it, it appears vaſtly larger. Round about this ſun rolls our earth, and with it the other five planets. Of theſe the two neareſt perform their revolution alone, or unattended; but three of the other four, calling the earth one, and thus raiſing the number to ſix, have leſſer planets rolling round them, the earth has the moon her ſatellite, Jupiter has four, and Saturn has five. It is ſingular that Mars, which is placed at a greater diſtance from the ſun than we are, ſhould have no ſatellite, but he has none. We look upon things as they appear to us from their diſtance, not as they are. The globe of Jupiter is in its ſolid contents nine hundred times as large as our earth, and his ſatellites, which are too diſtant to be ſeen by the naked eye, are each of them fully of the bigneſs of this earth; the fifth of thoſe of Saturn is much larger. We are not to be prejudiced from our near ſight of things therefore, or to be amazed that ſuch a vaſt globe as our earth ſhould roll round the ſun, accompanied by the moon; we find vaſtly larger, and more diſtant globes performing the ſame courſe, whoſe very attendants are equal to this earth, or more than equal to it in bigneſs.

Theſe planets revolve round the ſun in the following order. The neareſt is Mercury, then Venus, after that the Earth, then Mars, then Jupiter, and laſt Saturn. The four ſatellites of Jupiter were diſcovered by Galileo, and were ſome of the firſt things found out by the teleſcope; he called them the Medicæan ſtars, in compliment to the great duke of Tuſcany, who was his patron. Saturn, as more remote from the ſun, has five ſatellites; one of theſe was diſcovered by Huygens, the other four not till Caſſini's obſervations. Beſide the ſatellites, Saturn has a luminous ring ſurrounding his body, but at a diſtance of very many millions of miles; this greatly perplexed the firſt aſtronomers, and is not certainly accounted

counted for by the lateſt. Probably it is compoſed of a great number of ſatellites performing their revolution round the planet in concentric circles. It is evident, that the ring does turn about the body of the planet. Thoſe who have divided the heavens into ſeveral portions, as was at one time the cuſtom, call that ſpace, which is between this planet and Jupiter, the heaven of Saturn; that between Jupiter and Mars, the heaven of Jupiter, and ſo of the reſt.

The ſpace between Jupiter and the ſun is double to that between the ſun and Mars, a double to that which is taken up by Mars, the earth with the moon, Venus and Mercury all together, for the place of their revolution; the heaven of Jupiter therefore is a very large ſpace, and it is the ſame with regard to Saturn; ſo that theſe two planets, with their ſatellites, occupy a ſpace greater than thrice that of all the other planets together. The diſtance of Saturn from this earth is very great, but vaſtly beyond that, a ſpace of unlimited extent, filled with æther, is occupied by millions of fixed ſtars, globes of fire, that ſhine with their own proper luſtre, whereas the brightneſs of all theſe planets is only that light which they receive from the ſun. The immenſe expanſe in which they are placed is called the heaven of the fixed ſtars; and they are called fixed, becauſe they remain always at the ſame diſtances from one another. Theſe the antient aſtronomers have divided into conſtellations, under the names of various perſons, and of various animals; and the poets have on theſe grounded a multitude of fables, and complimented their patrons, the emperors, and the reſt of the illuſtrious.

The diſtance of the fixed ſtars is already obſerved too immenſe for ordinary calculation. Some idea may be however eſtabliſhed as to what the greateſt men have thought of it, when it is obſerved, that if a bullet was to be diſcharged from one of them, the very neareſt, and ſhould fly to the ſun with that rapidity with which it leaves the mouth of the cannon, it would be twenty thouſand years in reaching that luminary. The moſt remote that we ſee even by teleſcopes are not to be underſtood as the moſt remote in the heavens. That inſtrument has its limits like our eyes, although it reaches farther; but the extent of the heavens, and the creation, ſeems to have no limits. The heavens therefore appear indefinite in ſpace, and the ſtars unnumbered and unmoveable. Theſe, as they are truly ſo many ſuns, may be ſuppoſed all to have planets revolving round them; and thus the ſpace filled in a manner worthy the ideas we have of the creator. Huygens had given the planets the name of celeſtial earths; and it is probable, that they are in many reſpects like to this globe which we inhabit; and that as the plants and animals which abound with us, are formed out of the principles of this earth; ſo there are on theſe globes plants alſo, and animals formed out of the conſtituent particles of thoſe, and therefore calculated for living on them. We can eaſily conceive, that creatures like ourſelves, like the animals which inhabit this earth; or the plants which grow upon it, could not live in the extreme cold of Saturn, or in the extreme heat of Mercury, all muſt be ſolid ice in the former, and upon the ſurface of the latter the heat is ſo great that it will make water boil. But although creatures of our texture could not live in ſuch worlds, he who created us, and our world, and appropriated the one unto the other, could alſo form creatures proper for the other worlds he has created. We ſee that he has faſhioned them in many reſpects like to this earth, their form, their motions, and their ſeveral laws of the ſame

kind,

kind, he could as easily create inhabitants for them; and as he has not left with us a drop of water unpeopled with life, it is not to be supposed, that he has neglected such vast orbs. It is most probable, that the fixed stars, being, as they assuredly are, so many suns, every one of them has a number of planets revolving round it, for that is their use; and that thus the whole heavens are filled with worlds, and those worlds with inhabitants. An extent like this is much more agreeable to the majesty of the divine creator, than the supposing this little spot of all the millions that might have been formed on the same principles, and that therefore probably are so, to be the only part of the creation inhabited, and that the rest were made for us to look upon. This assuredly is not the case, since many of the fixed stars are beyond our sight, and even if all were within the reach of it, it is unworthy of our reason, and inadequate to the ideas we, in other respects, establish in our minds of the creator, that he should have made them only for our pleasure. We see that the sun and stars alone are bodies of fire, the planets we discover to be earths, like this, fit for inhabitants, and having like this the vicissitudes of day and night, and of the seasons, although at different intervals. The sole office of the sun is to give this light, and be the centre of their motion, for in itself it is not to be conceived that it can be of any use at all. If this be the case, why should we suppose so many suns as we see in the heavens under the form of fixed stars, created to be useless, or to spend their light, many of them with respect to us, wholly in vain, because we can see nothing of them.

It is not to be disputed but the Chaldæans very early studied the heavens; nay, it is certain, they were of all people, of whom any account has travelled down to us, the first who did so. They were favoured by their situation: they had an open country, and a clear air, and they were from generation to generation addicted to the study of the stars, but they pretended to more knowledge than they had. Mere observation must shew them that the planets moved along the heavens, whilst the fixed stars retained their places; and but for the perplexity occasioned by the earth's also moving, they would undoubtedly have found out the period of their several revolutions. The comets they must also have the same opportunities of knowing to have motion; but when we are told of their having had the art of foretelling their appearance, and predicting eclipses, we may know what we ought to think of the account, when we see added to it, that they could predict tempests and earthquakes, which we know to be impossible.

From these people, who doubtless distinguished the comets and the planets from the other luminaries of heaven, and who certainly had the division of the fixed stars into constellations, and, for ought we know, were the first who had it; the Greeks received their rudiments of astronomy; and whatsoever may be boasted by those who love to carry all knowledge back to the remotest antiquity; it is probable this, or a very little more than this, was all they learned from them.

The Greeks we find very early had ships. The Argonautic expedition is a proof of it; and Sir Isaac Newton supposes a great deal of the knowledge of the fixed stars to be from that period. It is certain, that persons who were out many nights together at sea, were the most likely to observe them. Toward the time of the Trojan war the Greeks, we find, were very intent upon the study, and the father of Agamemnon is celebrated by Euripides

Euripides as an aſtronomer. Palamedes and Aſtræus were cotemporary with the ſons of Atreus, and they are recorded to have added many things to the ſcience; ſome have aſcribed to them the conſtruction or invention of certain of the conſtellations. They aſcribe alſo the Great Wain to Nauplius, an aſtronomer of about the ſame period, as they do the Leſſer Wain to Thales, but all this is to be diſputed: theſe might revive the attention to what had been neglected; but the conſtellations in general were doubtleſs Egyptian. The Argonautic expedition was, as ſome ſay, twelve hundred years before the birth of Chriſt, and we hear of Muſæus, one of the heroes concerned in it, as having invented a ſphere; but we are not to conceive any very great things of ſuch an early diſcovery, or to ſuppoſe it like to what we now underſtand by the term.

The oldeſt of all the Greek authors who has mentioned the conſtellations is Heſiod, and he has named only a few of them, and theſe very imperfectly, and in ſuch manner, as to prove the very names of ſome of them were foreign. If we allow the Pleiades, the Hyades, and the ſingle ſtar Arcturus, to be of Greek denomination; certainly the Orion is foreign to that people; and Sirius, whoſe name is from Siris, one of the denominations of the Nile, which river was obſerved to ſwell at the riſing of that ſtar, muſt have been delivered to them from the Egyptians. Bootes and the Wain are all, beſide the conſtellations named in Heſiod, that we find mentioned by Homer; and indeed from the very words of that poet it ſeems, that no conſtellation had been ever formed to the north of the Great Bear. This is a circumſtance that gives ſome credit to the ſtory of the Leſſer Wain, being the invention of Thales; but we are to underſtand even this with due reſtrictions. If we look into the hiſtory of this aſtronomer, to whom Greece had been ſo much indebted for her improvements, we ſhall find that he ſtudied the ſcience in Egypt: why then may we not ſuppoſe, that thoſe things of which his countrymen are proud to call him the inventor, might be only what he had learned in that country; and firſt taught after his return in his own?

Indeed all things concur to give the origin of the Greek aſtronomy, and in a particular manner, to the Egyptians. We find Thales the man who firſt eſtabliſhed aſtronomy on a tolerable footing among the Greeks; and we find it alſo recorded of the ſame Thales, that he was the firſt Greek who travelled to Egypt to ſtudy the ſciences. Does not this ſay, beyond a doubt, that the Greek aſtronomy was brought from Egypt, and that Thales was not the inventor of all he taught his countrymen? Nay, if we look deeply into it, we ſhall find it ſo. The greateſt praiſe that has been beſtowed on Thales is, that he regulated and fixed the period of the year, determining it to conſiſt of three hundred and ſixty-five days. This is indeed recorded of him by old writers among the Greeks, but Strabo ſays the Egyptians made this regulation. Is it not plain that Thales, who ſtudied in Egypt, was taught this in that country, and that his countrymen ſuppoſed he invented it becauſe he firſt informed them of it? They ſay of him alſo, that he predicted an eclipſe; a thing impoſſible, if we conſider the ſtate of aſtronomy in his time. Herodotus is ſuppoſed to have ſaid this, and we underſtand by it what we ſhould at this time underſtand by the expreſſion; but if Herodotus be conſulted, it will appear he only ſays the aſtronomer foretold that ſuch a thing would happen ſome time within the compaſs of ſuch a year. We are, with the ſame reſtrictions, to underſtand whatſoever elſe is ſaid

of his discoveries, or we shall suppose the astronomy of that time much better than it was. We find eclipses, when they have surprised Greece long after the time of Thales, looked on as portents and indications of the wrath of heaven; but this would not have been the case if they were before known to be natural occurrences, and capable of being predicted.

Thales lived between five and six hundred years before the birth of Christ, and if we consider the time and the state of astronomy before him, we shall think very greatly of him if we believe but a small part of what is recorded. Parmenides, who lived about a century after him, added a great deal, and improved on many of the discoveries which he had brought imperfect from the Egyptians, or which he had made from his own observations, and had not time to complete. The invention of the terrestrial zones, which Strabo gives to Parmenides, robs Thales of the glory of inventing the celestial, which, it is evident, were an after-discovery, but at the same time it sets the history of astronomy on a much better footing.

Anaximander, who must have succeeded Thales also, for he declares himself to have been his scholar, gives evident proof, by the doctrines which it is his honour to have established, that the astronomy of Thales could not be, by any means, so perfect as many have supposed it. He seems to have first discovered that the moon borrowed her light from the sun, and it is an unfair reflection on his memory in those who say he taught the contrary.

The obliquity of the ecliptic is reckoned among the number of those improvements which Anaximander made in the Greek astronomy, and he has the undoubted honour of being the first writer who has spoken of it. The gnomon is also said to be one of his discoveries, but it is evident from what we read of the Babylonian discoveries, that they must have had it in use long before. All that is said of these old writers and improvers of the science, is to be understood with great limitation. The whole truth in this case can only be, that Anaximander applied the gnomon, which had long been in use in other places, to new purposes in astronomy. Ptolemy expresly tells us, that Meto observed the solstice with a gnomon, and he fixes the time of this observation to a period prior to the Peloponesian war by one year, that is, he makes Meto to have used the instrument four hundred and thirty-two years before the birth of Christ. This is that Meto who published his cycle of nineteen years, which himself called the cycle of the moon; but others, in honour to his memory, have named it the Metonic cycle.

If there be a name more famous than that of Thales for the improvement of astronomy among the Greeks, it is that of Pythogoras; he lived five hundred and odd years before Christ, and was sixty or seventy years later than Thales. There is no disputing his title to the improvement of astronomy in a great degree among the Greeks, and if we enquire into his history, we shall find that he spent a great many years in Egypt, and was famous for his good intelligence with the priests of that country, who were the people most eminent in knowledge, not only in astronomy, but in all the other sciences. The system which goes by his name, and which he is, according to the custom of his country, said to have invented, he probably brought from Egypt, and being the first that taught it in Greece, he was there called the inventor of it. But with all the boast that is made of the astronomy of those times, we shall have but a very moderate opinion of it when we find one of the established doctrines to have been, that the sun was only

three times as far off from the earth as the moon: or, if we take the largest account, and give credit to those who say they made it six times as distant, still the absurdity is sufficient.

The antiquity of observations on the heavens is then, beyond all doubt, to be given up to the Egyptians, but there is enough to be allowed to the Greeks. They were absolutely the first who called in geometry to the assistance of astronomy. We see by a thousand instances in the earlier periods, that this was never thought of, and we see by as many since, that, without this, nothing could be done to purpose in the science. It is pretended that they invented the constellations, nay, Pliny goes so far as to say who invented them, he gives the honour to Cleostratus, but it is plain enough how little credit is to be paid to such accounts, when we have proofs of their having been mentioned and referred to many hundred years before him. We read of certain treatises which this Cleostratus wrote on some of the constellations, and that is all that is to be conceived of him. This a vain people, like the Greeks, might easily extend to his inventing them. But it is unlucky that the very constellations are named and proved to be of a great deal earlier time. Aries, and Sagittary, and Gemini, are the three, and it will be hereafter sufficiently shewn, that all the signs of the zodiac were prior to the name of astronomy among these boasting people. From this time they claimed more and more in the title of inventors of astronomy, and adapting the histories or fables of their country to the several figures of the constellations, claimed from thence the having invented them, but it is not only in the zodiac that their claim is refuted. The several stories they tell of the occasion and origin of the others assure us, that they were wholly ignorant what that occasion and origin truly was. If we examine, for instance, the kneeling figure by Bootes, and the Crown, we shall find some of their authors saying that it is Hercules, others that it is Theseus, and others Cetheus, the father of the nymph transformed into the Great Bear, whom these assert, not to have been Callisto, the daughter of Lycaon, but Megisto his niece, and daughter of this Cetheus. Can any thing be truly collected from this, except that they received this figure of a kneeling man from elsewhere, in other words, from Egypt, and that they fathered at times different parts of their history upon it, not knowing what to call it. Nay, we find that some of them, and probably they were the wisest, did not pretend to say what it was, for they gave it no particular name at all, but called it Engonasin, a man on his knees, and thus Ptolemy names it.

Eudoxus, who wrote three hundred and sixty years before the birth of Christ, is another to whom the Grecian astronomy has great obligations; he is also another of those Greeks who travelled into Egypt. This is a material part of his history; we are even told that he obtained the interest of the reigning sovereign to introduce and recommend him to the priests of that country, and that he wrote some of his works, not only on the foundation of what he had learned there, but even while he was in the place, and under the eye of his instructors. Thus we see Egypt still the country of science, and all its treasures derived thence. It was Eudoxus who taught the Greeks that the year consisted of three hundred and sixty-five days and six hours, adding that fraction to the account of Thales; and it is undisputed that he owed this, as well as Thales did the other account, to the Egyptians. We have proof also that he wrote on the subject of the constellations: we have the surest of all proof, for Hipparchus has preserved many parts of the work, and gives them as such. Does not this also

with the rest attribute the knowledge of the heavens originally to the Egyptians? or, are we to doubt but that he wrote this part of his works, as well as the rest, upon the foundation of what he had learned there, and that he gives the constellations names as he received them. He may have added observations, but doubtless he wrote upon the figures as he found them, for what he had so received he would hold sacred.

As Hipparchus has preserved to us a part of Eudoxus, we owe to Ptolemy that knowledge which we have of Timacharis from his writings, for what we know of them is preserved in the syntaxis of that elaborate and faithful writer. He wrote about three hundred years before the birth of Christ, and as his works consisted of observations of the heavens, and these were made at a time when the Grecian astronomy had received some degree of improvement from the Egyptian, it is a misfortune to the world that they are lost. We might as well give to Eratosthenes, who published his works twenty or thirty years after, the credit of inventing those of constellations, which were the subject of his observations. Indeed partly the obscurity of the times, partly the loss of the writings, and partly the vanity of the Greeks in general, have made it almost impossible to distinguish where they are original, and where they only retail to one another the knowledge of the Egyptians concerning these early observations of the heavens: when we come to trace the rise of astronomy as a science, it is indeed all their own.

Aristarchus was a little later than these, and he has immortalized himself, and worthily, by his conjectures, not to call them absolute calculations, of the earth's distance from the sun, of the moon's distance from the earth, and of their comparative magnitudes; these being founded on the moon's dichotomy, must have a true mathematical foundation, and this we are to allow was not the growth of Egypt. From this time the science flourished on these true and certain principles. Archimedes soon followed, and with him a vast quantity of real knowledge; he assigned, with a surprising accuracy for that time, the places and distances of the planets, and laid the foundation of what has done so much and so true honour to astronomy.

Hipparchus followed in the next age, and being perfectly acquainted with all the principles of Archimedes, and reverencing him as he deserved, he carried on the designs, pointed out by what he had left, to vast improvement in comparison of all that was past.

Hipparchus had the opportunities of a long life, and an early application; there are proofs from what Ptolemy has recorded of him, that he continued his observations more than forty years. His observations on the sun, and his attempt to determine the parallax of that luminary, will be an honour to his name: and there is another article that is scarce less so: it was he who, according to all account, first set about that difficult and useful work, the making a catalogue of the fixed stars. His own words indeed convince us, that it had not been before attempted, and the uses of which, he says, it must needs be, concur in shewing it quite new. The appearance of one of those stars, which astronomers call new ones, gave origin to the attempt, and be succeeded in it to a miracle. Ptolemy, whom we reverence so highly, and who lived at so great a distance after Hipparchus, as in the hundred and fortieth year of the Christian æra, follows him in all things, we frequently find him confessedly fearing to depart from him; and much of that knowledge, which we reverence in this author, is truly the knowledge of Hipparchus.

From Ptolemy we may date the great progreſs of aſtronomy throughout the world, before what had been learnt from the Egyptians, had been in a great meaſure confined among the Grecians. Ptolemy wrote for all mankind: his ſyſtem was publickly taught every where, and his writings tranſlated not only into Arabic, but almoſt all the other languages. The ſyſtem of Ptolemy was looked upon as ſacred truth beyond all diſpute. It was long after him, however, that Europe received the true taſte for the ſtudy of the heavens. Spain was the country where it firſt flouriſhed, but we can have no very high idea of its ſtate among the Moors. It was not till almoſt eleven hundred years after their publication, that the works of this author were tranſlated into Latin, and that aſtronomy became a ſtudy regarded by the learned in this quarter of the world; in which it has at length arrived to an height, as much above all that it reached in Greece, as the higheſt pitch of the Grecian knowledge was above the Egyptian. Indeed it is only within theſe hundred years, or thereabout, that the heavens have been underſtood, and all that was before delivered is ignorance, in compariſon with what is now eſtabliſhed, and explained amongſt us.

HELICE. A name by which many of the old writers have called the Great Bear. *See* URSA MAJOR.

HELLESPONT, *Climate of.* A name given by the antients to what they called their fifth climate, north of the equator; but this was not the moſt received name, it was more generally called the climate of Rome; the ſixth was that of the Boryſthenes; and the ſeventh that of the Riphean mountains.

HEMITOCLES HIPPUS. A name by which ſome, who love uncommon words, have called the Horſe, or Pegaſus; it is one of the old Greek names of this conſtellation.

HENIOCHUS. A name by which ſome call the conſtellation Auriga; it is one of its old Greek names, and it ſignifies the ſame with Auriga, one who hold the reins, or guides a carriage. *For the account of this conſtellation, ſee the article* AURIGA.

HERCULES. One of the conſtellations in the northern hemiſphere, and one of the moſt conſiderable among them. We find it mentioned by the old writers on aſtronomy, and by many who have only occaſionally ſpoken of the ſubject; but this under different names, ſome calling it Theſeus, and ſome Cetheus. It is one of the old forty-eight, with which the earlieſt writers, of whoſe works we have any knowledge, were acquainted; it is of a great extent both in length and breadth, four or five times as large as Lyra and the Northern Crown put together, and it contains a proportioned quantity of ſtars.

The figure under which it is repreſented is that of a man kneeling, holding forth one hand, the left with the fiſt clenched, and in the other holding up a club, he kneels only on one knee, and is repreſented naked, only with a lion's ſkin behind him, a part of which, with the claws, is ſeen a little below his ſhoulder, and a part round his waiſt.

Hercules is ſituated between the conſtellations Ophiucus, Serpens, Corona Borealis, Bootes, Lyra, and Anſer. The head of Ophiucus almoſt meets with that of Hercules, the head of the ſerpent almoſt touches the arm that holds his club, the Corona Borealis is by his right ſide, Bootes's head almoſt touches the foot of his kneeling leg, the Dragon is under his feet, the Lyra is near his clenched, or left-hand, and the Swan oppoſite to his left ſhoulder.

The antients counted twenty-nine ſtars in

in the conſtellation Hercules. Hipparchus inſerted ſo many in his catalogue, the firſt that was ever made of the fixed ſtars, and we find the ſame number in Ptolemy. Tycho reduced them to twenty-eight, but Hevelius raiſed the number to forty-five, and Flamſtead afterwards to one hundred and thirteen; but of all this number there is not one of any conſiderable ſize, there is not a ſingle ſtar ſo big as of the ſecond magnitude, there are very few even of the third, the reſt moſtly of the fifth and ſixth; ſo that, with all its extent, Hercules is not one of thoſe conſtellations that attract in any part the eye of the vulgar.

There are but few of the ſtars in the head of the conſtellation. In the neck there is only one, and that ſtanding diſtant from any other is as conſpicuous as any part of the conſtellation, and is as ready a character of it to the young obſerver as any. There are five or ſix in the club, and about as many in the right arm, one of which that ſtands ſingle toward the ſhoulder is one of the largeſt in the conſtellation. The left arm has two or three more than the right, and there are two more on the hand, and two other unformed ones very near the wriſt. The body has a conſiderable number, but the largeſt and moſt numerous are toward the belly, there are ſome on both thighs, ſome ſmall ones on the right leg, particularly three in a cluſter toward the anckle, and five or ſix conſpicuous ones on and about the left foot.

The Greeks have never been wanting to adapt part of their hiſtory to the ſigns in the heavens. It was no ill compliment to the names, which they wiſhed to honour, to ſuppoſe the perſons to whom they had belonged, taken up for their ſucceſsful courage into the heavens. Beſide, it anſwered another purpoſe, it flattered the vanity of that people in blinding to the world their obligations to the Egyptians. Aſtronomy flouriſhed among them, and they would be ſuppoſed to have invented it. It is indiſputable, that they received the twelve ſigns of the zodiac from the Egyptians; nay, it is even plain, that the Egyptians themſelves brought them from elſewhere, for they do not anſwer to the ſeaſons of Egypt; they are therefore very antient, and it is probable, that the reſt, if not altogether as old, becauſe not quite ſo uſeful, yet were ſoon after them invented, and that the conſtellations in general, as well as thoſe twelve, were received by the Greeks from Egypt. It has been the more proper to take notice of this under the head of this conſtellation in particular, becauſe it is evidently one that they knew not what to make of. It has been already obſerved, that they called it ſometimes Hercules, and ſometimes Theſeus, and ſometimes Cetheus, the father of Megiſto, whom, and not Calliſto, they will have to be the Bear at this time in the heavens. The earlieſt writers of all have called it by no one of all theſe heroes names, but have ſimply named it Engonaſin, a man on his knees; it is under this name that Ptolemy mentions it in his catalogue. Is it not plain from this, that they received the figure from elſewhere? that among the other ſigns of the heavens they ſaw certain of the ſtars arranged into this ſhape, and that they called it a kneeling man, knowing nothing of what the Egyptians, who delivered it to them, meant by it. After this the Greeks of ſucceeding time, eager to honour ſome of their gods or heroes with every figure in the ſkies, firſt applied it to Cetheus, the father of the neighbouring Bear, once a virgin and a princeſs, afterwards to Theſeus, whoſe memory was naturally called up by the Crown which they had called Ariadnes, and which was juſt beſide this figure; but at laſt they gave it to Hercules.

The

The Dragon, which is placed just below the feet of this constellation, they had already said to be that which guarded the golden apples of the garden of the Hesperides, which Hercules slew, and which Juno, in whose service it had been engaged, transplanted into heaven. Nothing was then so natural as to make the human figure over it, that Hercules who conquered and destroyed it. According to this fable of their origin the two signs are the hero, and the monster, just preparing for the combat, the Dragon is represented as with its head raised up for the attack, and the hero kneeling on one leg, and with the foot of the other in act to tread upon it, while his club is raised to give the fatal blow. Those who tell this story leave nothing to Juno; they say, that Jupiter saw and admired the combat, and that he took both up to heaven.

Those who would adapt the constellation to Cetheus, took away the club, and suppose him kneeling, and lifting up his hands to heaven to have his daughter the Bear restored to her human shape. Those who make it represent Theseus, alter the figure, yet they continue him kneeling on one knee, but they bring both his hands down, and suppose him in the posture of lifting up the vast stone under which Ægaus had buried the Elopian sword, with command to his mother not to let him go to Athens till he should have taken it up.

Others make the constellation represent Thamyris, blinded by the muses, others Orpheus kneeling to the bacchanals, the harp which is before him answering very well to these conjectures as belonging to him, and even to Theseus, who has been celebrated for his skill on that instrument. Some others have called it Ixion, with his hands bound behind him, and others Prometheus bound to Caucasus; and finally others, who have continued the name of Hercules, have taken away the supposed connection with the Serpent, and have supposed it that hero kneeling in his distress to Jupiter, when after he had wasted all his arrows on the Ligurians, and stood exposed to their fury, he prayed for stones to throw at them, with which he vanquished them.

I have introduced the mention of these several stories, as to the origin of this constellation, to shew how confused the Greeks themselves were as to the accounts they gave of these things; and to evince the truth, at least the probability, of their not having been the inventors of the several constellations, from their not agreeing in the story of what was the occasion of their being invented. All this pains has been taken to account for a figure which they had from the Egyptians, and which, among that people, was probably no more than an emblematical way of saying, piety carries men to heaven.

Hercules is a name also given by some of the Greek writers to the constellation Gemini. They suppose the two figures in that sign to be Apollo and Hercules, others call them Triptolemus and Jason, and more Castor and Pollux; they were originally a pair of kids. The Egyptians taught the knowledge of them to the Greeks, and what could they know of one or other of these famous people? *See the constellation explained under its proper name* GEMINI.

HERCULES LYDIUS. A name given by some of the old astronomers to the constellation Ophiucus, or Serpentary. They say, it was designed in honour of that hero for his killing the famous Lydian Serpent of the river Segaris, which destroyed all the country, and they give the epithet Lydian, to distinguish it from

from the other Hercules killing the Hesperian dragon, which, being the oldest, is, by way of eminence, called, simply, Hercules. *See the article* OPHIUCUS.

HERMEDONE. A name by which some writers have called that part of the constellation Pisces which is extended with certain convolutions from one of the two fishes which compose that constellation to the other. This has, by some, been called a stream of water, and by others, more rationally, a cord or line, as it ties the two fish to each other. The word Hermedone is Greek, and is used by some of the oldest writers in that language. The commentators, who are always ready enough at etymologies, say, that it signifies Hermetis Donum, the gift of Mercury; but it is much more probable the word was Harmedone, a knot or bandage, or Harpadone, which signifies a cord or chain. Others call it Syndesmus.

HERMIPPUS. A name by which some affect to call the Dolphin. It is not a new term, for we find Pliny, and some other of the old writers, calling it by this denomination.

HERON. A name, but an improper one, for one of the constellations of the southern hemisphere; it is called by the inventors of it Grus, so that the proper English name is the Crane.

HESPERUS. A name given by many of the Greek writers to the planet Venus, which they make by this a male, and not a female, as those do who call it after the name of the goddess. They were for having the honour of the invention of astronomy, and that all might seem to have been done in their country, they adapted a part of their history, or of their fable, to every constellation, and to every planet. They say the Bear was their Calisto, whom Jupiter first converted into another creature on earth, and then raised up into the heavens: They say the Dragon of the sphere was that which guarded the Hesperian fruit, and so of all the rest.

In the same manner they have given accounts of what they call the origin of the planets. Jupiter, which they called Phaeton, they say, was a man of that name, the most beautiful in the world, whom the gods made a planet in the heavens. Saturn, they say, was the other Phaeton, the son of Phœbus, and they tell us, that when Jupiter struck him dead with thunder, his father Phœbus took him up into the skies, and made of him that planet: they call this Filius Solis, to countenance the story, and say it was therefore placed at the remotest distance from the sun, because it had already suffered too much mischief from it. Mars, they say, was Hercules taken burning from the Pyre, and therefore that it is of a ruddy colour; they also call it Stella Herculis to countenance the story. This Hesperus, of whom they have made the planet Venus, the largest, as they call it, of all the stars, they say it was once a mortal also of this name, a son of Aurora by Cephalus. They tell us he was the handsomest of men, and that he even vied with the celestials, and challenged Venus to the trial before any judge. When he died, he was taken up into the heavens, and made a star bright as he used to be in his person, which still is attendant, a great part of its time, on the imaginary parent, and is seen preceding the morning. Nothing can be so idle and absurd as these stories are, yet from such as these it was the Greeks expected to be called the inventors of astronomy.

Hesperus is also a name by which many of the old writers have called Venus, who applied

the term to her only when ſhining in an evening after ſun-ſet. When ſhe appeared before ſun-riſe in a morning they called her Phoſphorus and Eoſphorus, the bringer of light and bringer of the morning. The poets all mention her, and, from the brightneſs of her light, which they celebrate under many epithets, they call her the fineſt and moſt beautiful of the ſtars. We find the name Phaeton applied by the ſame writers to one of the planets, and might be naturally enough led to ſuppoſe it this, but it is evident they applied that name to Jupiter. They did not ſuppoſe that planet ſuperior, but equal to Venus in luſtre; but ſhe having already many ſounding names, they gave this to Jupiter, as deſerving it in compariſon of the other ſtars.

HESTER's CROWN. A name uſed by ſome of the later writers on aſtronomy. There are alſo ſome of theſe who will have every conſtellation refer to ſome part of the ſcripture-hiſtory, and they make this repreſent the Crown worn by that queen.

HETEROSCII. A term uſed by the old aſtronomers and geographers to diſtinguiſh the inhabitants of certain parts of the earth by the place of their ſhadows at noon. There are ſeveral other terms alſo anſwering the ſame purpoſe, ſuch as the Aſcii, thoſe, who, on certain days of the year, have the ſun at noon vertical or ſtrait over their heads, and have, at that time, no ſhadows: and the like. Theſe are explained in their ſeveral places.

The term Heteroſcii is uſed to expreſs thoſe who live in ſuch parts of the globe that their ſhadows at noon always fall the ſame way. It is a term of diſtinction from the Amphiſcii, thoſe who have their ſhadows not always the ſame way, but at different times of the year to the north and to the ſouth.

All this depends upon the ſun's continual change of place within the tropics, and his never going beyond them; whence it naturally follows, that thoſe who live between the tropics muſt have theſe differences in the diſpoſition of their ſhadows, and that to thoſe who live out of that part of the globe, they muſt be always directed the ſame way.

The ſun never is two days together in the ſame place in the heavens. At the vernal and autumnal equinoxes he is at the equator, and on all the times between he is declining either north or ſouth toward one of the tropics, or returning back again from that declination. Thoſe who live under the equator therefore have the ſun vertical on the tenth of March, and on the twelfth of September, and at other times of the year they have their ſhadows ſometimes to the north and ſometimes to the ſouth, and the caſe is the ſame with all thoſe parts of the globe that are between the tropics. The inhabitants of all theſe places are therefore Amphiſcii, or have their ſhadows the two contrary ways at different ſeaſons of the year.

It is in diſtinction from theſe that the term Heteroſcii is uſed, its ſenſe is, people who have their ſhadows at noon always in the ſame direction; all thoſe nations come under this denomination who are without the tropics, for the ſun never becoming vertical to any of them, can never go beyond any of them, and therefore being always on one ſide, their ſhadows always fall on the other. Thus thoſe people who inhabit countries to the north of the tropic of Cancer, which is the caſe with all Europe, as the ſun never comes to the north of that tropic, will always ſee that luminary ſouth, and conſequently their ſhadows will always fall north at noon, we therefore, who inhabit this part of the globe, are all contained under the denomination of Heteroſcii, and, in the ſame manner, thoſe who live to the ſouth of the

the tropic of Capricorn, the ſun never coming to the ſouth of that tropic, will always have their ſhadows ſouth at noon, as the ſun will always be to the north of them; and theſe, as well as the others, having their ſhadows always the ſame way, are comprehended under the name Heteroſcii. When in ſpeaking of theſe things the ſun's motion is mentioned; it is to be underſtood as done in compliance with the common cuſtom and forms of ſpeaking. The ſun, we very well know, ſtands always ſtill in the centre of the univerſe, and it is the earth that moves; but to us, who, living on that earth, do not experience its motion, the appearances are as if every thing elſe moved, and the generality of men have accuſtomed themſelves to ſpeak of theſe things as they appear, and not as they are. It is more familiar to ſpeak in the uſual form. Thus we ſay, that the ſun is half the year declining to one of the tropics, and returning from that declination; and the other half year the ſame with reſpect to the other, and hence ariſe all the changes in the place of ſhadows within the tropics.

HEXAGONUS. A name given by the old Greeks to that aſpect, as it is ſtiled, of the planets, and the conſtellations, ſuppoſed to be allied to them, which the Latins calls Sextilis. This is the aſpect they are in when at ſixty degrees diſtance from one another, and in this, as well as in the four other aſpects, they are ſuppoſed to ſhed mutual radiations upon one another, and, as thoſe people phraſe it, to co-operate together with reſpect to human affairs.

All this is jargon and frivolous error; but we are not to wonder that it has place in the old writers. Aſtrology, though now properly laughed out of the world, was in the early times joined with the ſcience of aſtronomy, and when ever we read of one we read of the other. The other four aſpects were thoſe of conjunction and oppoſition; in the firſt of theſe the planet and conſtellation were together, and in the other at one hundred and eighty degrees, or half a circle, diſtance; and the quadrate, and the time or trigon; in the firſt of theſe the diſtance was of ninety degrees, and in the other of one hundred and twenty.

HIEROS ICHTHYS. A name by which ſome, who are fond of hard words, call the conſtellation Delphinus, the Dolphin; they call it alſo Piſcis Sacer, the Holy Fiſh.

HIMARAN. The name by which thoſe, who follow the Arabian writers, call the two bright ſtars in the conſtellation Cancer, commonly called Aſelli. *See* CANCER.

* HIPPOCAMPUS. A conſtellation offered to the aſtronomical world in the plates of this work, and compoſed of certain conſpicuous and unformed ſtars under the feet of the conſtellation Taurus. It is of ſome conſiderable extent in the heavens, and, for the ſpace it occupies, is ornamented with no inconſiderable number of ſtars, and theſe are all happily diſpoſed, and ſome of them ſufficiently conſpicuous. The creature from which it takes its name is one of the moſt ſingular animals in the world, it is frequently met with dried in the collections of the curious, and its long and narrow head, its curled body, and bent neck make it very remarkable. It is a fiſh of the Syngnathus, or Needle Fiſh kind. Moſt of the naturaliſts have named it, and it is deſcribed and figured in the hiſtory of animals, publiſhed ſome little time ſince by the author of theſe obſervations.

The Hippocamp is placed between Orion, the Bull, the Whale, and the Eridanus. There is a vacant ſpace between theſe in the centre of which are ſeveral looſe ſtars, and this figure comprehends them all. The head of the Hippocamp is pointed at the breaſt of the Whale, and comes between the head of that monſter and Eridanus. Its tail points at the ſide of Orion, and comes near to the lion's ſkin he holds up in his left hand. The fore feet of the Bull are over the hinder part of its body, and the Eridanus runs in ſome degree parallel under it. There might be an objection ſtarted againſt the making ſo ſmall a fiſh as the Hippocamp extend over ſo large a ſpace of the heavens; but there is an example very near at hand, that proportion has not been obſerved between the ſeveral figures. When we ſee the paw or fin of the Whale cover the whole breadth of the river Eridanus, we are not to except againſt making the little Hippocamp longer than the club of the Great Orion.

The conſiderable ſtars in the conſtellation of the Hippocamp are twenty-one, there are many of them very conſpicuous, and their exact places and ſituations will be ſeen in the figure of the conſtellation, which is given in the ſame plate with that of Taurus. They are in general terms diſpoſed in the following manner. In the head there are four, two near to one another about the end of the ſnout, and two others near alſo to one another about the upper part of the head, theſe are all ſmall, but diſtinctly enough to be ſeen. In the riſing part of the neck there are two near the upper out-line of the figure both large, but the hinder one the larger and brighter; in the deſcending out-line of that bend there are four, three near the ſame out-line, and one more in the body, the lower one of the three, and the ſingle ſtar are both large and bright. In the lower part of the bend, near the out-line are three, one larger, and diſtant two ſmaller, and near to one another; beyond theſe, in the out-line alſo, are three in a cluſter very near to one another, one of theſe is large, and two are ſmaller. A little beyond theſe, near the upper out-line, are two very conſpicuous, and the three laſt are at the tail, one at the extremity of it, and two a little diſtant, one in the upper, and the other in the lower out-line. By theſe the whole figure is very well deſcribed.

HIPPOLATES. A name by which ſome have called the conſtellation Auriga; it is one of the old Greek names. They called it alſo Elaſippos, Hamiclates, and Diphralates, all which names have, in the ſame manner, got from their writings into the books of our aſtronomers and aſtrologers.

HIRCUS ÆQUORIS. A name by which ſome of the Latin writers have called Capricorn. They give it this name to account for its being half a goat and half a fiſh.

* HIRUDO. A conſtellation offered to the aſtronomical world, and compoſed of a ſeries of conſpicuous unformed ſtars over the head of Orion.

The creature, under whoſe out-line theſe ſtars are arranged, is the common Leach; the inſect uſed in bleeding; common in ſhallow waters, and deſcribed by all the writers on natural hiſtory.

It is a ſmall conſtellation; but in proportion to the little ſpace that it occupies in the heavens it contains a conſiderable number of ſtars. It is repreſented under the figure of that animal, not ſtretched out at length, but in its ordinary poſition bent, and with the head directed back again toward the tail. The ſtars are very happily comprehended under the

lines

lines of this figure, and there is this peculiar advantage, that as a part of them are much larger than the others, those are all disposed toward the tail, and the small ones run in a series along the part toward the head, which, when the creature extends itself, is much the smaller part of its body.

The constellations between which the Hirudo is placed are Orion and the Bull, and these are so disposed that there are no others that can properly be called in to ascertain its place. The lion's skin in the left hand of Orion is held up to the knee of the Bull, and his club is in such a position as to come very near the top of the horn; by this means, between the two arms of Orion and the front of the Bull, there is left a space vacant, and in that part of this space, which is just over the head of Orion, stands the new constellation. Its tail, or larger extremity, is near the back part of the head of Orion, the thicker portion of its body runs parallel with the club in his right hand, and the bend toward the smaller part comes near the horn of the Bull; from this the head is bent again downwards, and is pointed toward the crown of Orion's head, but at a greater distance than the tail.

The conspicuous stars in the constellation Hirudo are twenty, and eight of these, which are toward the head are of the smallest magnitude that can be called conspicuous; there is a ninth among them a little larger, but it owes its seeming size to their particular littleness. They are disposed about the figure in the following manner: there is one small star in the top of the head: at some distance from this there is a cluster of six, of these two are in the lower out-line of the figure, and three in the upper, and one is on the body; this single star is that of the first nine that is larger than the rest. At a distance beyond these there is another cluster of two, also small ones, these are the last of the nine little stars of the constellation; after these stands a single larger star in the upper out-line, beyond this there is another single one of nearly the same size also in the upper out-line, then there are three following one another along the lower outline; beyond these there are five in a cluster, or rather in two clusters, three of them are against the upper, and two against the under out-line. The twentieth is a single star, and is placed in the centre of the hollow of the tail.

HO. A Chinese name for the planet Mars. The proper sense of the word is *Fire*. It is to be observed, that all astronomers, in whatsoever language they have written, have agreed in calling this planet by a name expressing also Fire. The Greek astronomers call him Pyrois; and the names Azen and Azer, by which he is called in many of those of the middle ages, are Persian terms, importing the same signification. The ruddy colour of this planet in the heavens has doubtless given occasion to this imagined similitude with fire.

HŒDI. A name given by the old Romans to two bright stars in the arm of Auriga. They had the custom of calling them by this name from the Greeks and the Arabs, and all other nations also, in which astronomy has been cultivated, have called them by some word, expressing kids or young goats. These were among the number of stars that were terrible to sailors. The weather was generally tempestuous about the time of their rising, as also at their setting, and according to the credulity of those times, they were supposed to be the causes of those tempests which they presaged. We find them universally distinguished by the epithets of horrida et insana sydera.

Manilius goes so far as to say, that they bar up the sea during that period in which they exert their influence; and Vegetius, who calls them Hœdi pluviales, for there were always rains accompanying the tempests they called up, as was the opinion of those times, joins in the same opinion. Germanicus distinguishes them by the name of

Nautis ininimicum Sydus in undis:

and the day on which their influence was supposed to cease, was called Natalis Navigationis, and we find that it was celebrated by the antient Greeks and Romans with festival games. The setting of Arcturus, and the rising of the Hœdi, were the two great presages, or causes, as they were called, of tempests. Virgil gives the strictest caution about them in his mild and gentle way:

Prætorea tam sunt Arcturi sidera nobis
Hædorumque dies servandi.

And Horace, in his spirited and rapid manner, couples them together in the same sense, as the most terrible of all things, to those who depended upon the effects of commerce and navigation:

Nec sævus Arcturi cadentis
Impetus, aut orientis Hœdi:

But we find both these were understood to presage storms at their setting as well as rising, only that those which attended the rising of Arcturus were less, and those which attended the rising of the Hœdi greater, than those which followed their several settings.

HOMOGENEAL RAYS. The whole body of light is understood to be composed of minute particles of matter. This light, as divided into rays, consists of particles differing in size between ray and ray, and to this is owing the division. To this also is owing that some of them are more, and some less, refrangible and reflectible. The rays, which consist each of a quantity of these pure and distinct particles, are called homogeneal, they are known by the colours they produce; that which consists solely of the largest rays, produces red, that which has solely the smallest, violet colour. To this also is owing each colour. *See* COLOURS *and* REFRACTION.

HOPEUTUS. A name by which some, who are fond of uncommon words, have called the constellation Capricorn; it is the Coptic name of that sign, and the signification of the word is Brachium Sacrificii, the Arm of Sacrifice. *See* CAPRICORN.

HORIZON. A circle round that part of the earth in which we are, and which is cut exactly into two halves by the meridian. This is called the sensible horizon by way of distinction from the rational horizon: so astronomers call a great circle of the sphere which is parallel to that horizon, and the plane of which is supposed to pass through the centre of the earth. *See* CIRCLES *of the Sphere.*

HORSE. A name of one of the constellations of the northern hemisphere, more usually called Pegasus. *For the number and disposition of the stars composing it, see* PEGASUS.

HORSE'S HEAD. A constellation of the northern hemisphere, more usually known by the name of the Equi Sectio and Equuleus. *See the article* EQUULEUS.

HORSE AND BEAR. One of the Arabian constellations, it is in the place of the old Centaur. The Arabians were not permitted by

by their religion to draw human figures, ſo they were forced to make theſe alterations.

HORUS. A name by which the Egyptians, and many after them, called the ſun.

* HOUNDS. A name of a conſtellation in the northern hemiſphere, added of late years to the forty-eight old ones, and compoſed of ſome of the unformed ſtars, or thoſe left out of the out-lines of thoſe original figures. The Greyhounds, or Hounds, (for they are indifferently called by one or other of thoſe names) have been diſtinguiſhed by the titles of Aſterion and Chara; they are coupled by ſtrings from their collars, and are held by Bootes, and ſeem barking at the Great Bear. *See the article* CANES VENATICI.

HOUR CIRCLES. A term uſed by aſtronomers to expreſs certain ſeries of circles, twelve in number, which are ſo marked that their planes all paſs through the centre of the ſun in the courſe of a natural day, that is between the noon of one day and the noon of the next. To figure to ourſelves theſe hour circles, we are to conceive twelve great circles of the earth, one of which is the meridian of the place where the obſervation is made, and to make theſe interſect one another at the poles of the earth, and divide the equator into twenty-four equal parts. In the rotation of the earth the quantity of fifteen degrees in theſe circles anſwer to an hour in time, and conſequently that place, which is juſt fifteen degrees eaſt of another, comes to point at the ſun juſt an hour ſooner than the other in the courſe of the revolution. Thus there is eſtabliſhed a meaſure of time, as well as of ſpace, for the fixed expreſſion of diſtance of any two places, and theſe circles may be ſo divided as the hour may be as eaſily, as the degree, parted into minutes.

HOUR CLIMATES. We find among the antients a diviſion of ſo much of the ſurface of the globe, as was known to them, made into climates by the names of the beginning, middle, and end of which they deſcribed the ſituation of places north of the equator, as we do by degrees and minutes of latitude. Each climate among them comprehended ſuch a quantity of ſurface of the globe, that the longeſt day at the one extremity, and the longeſt day at the other, differed half an hour.

The antients, believing all about the line uninhabitable, gave themſelves no trouble about it, but began at that parallel, where the longeſt day was twelve hours, and three quarters, and from hence meaſured out ſeven climates at the ſpace determined by an half hour's difference in the length of the day, the laſt of theſe was that in the centre of which lay the Riphæan mountains. But the later writers, who have followed the ſame diviſion, have been more correct. They have reckoned the different climates in the ſame manner by the increaſe of an half hour in the longeſt day, but they have begun at the equator, and have continued this admeaſurement to the polar circle, where the longeſt day is actually twenty-four hours, and all theſe climates, between the equator and the polar circle, they call hour climates; on the contrary, thoſe between the polar circle and the pole, as they are reckoned by greater meaſures of time, they call by a different term Month Climates.

HUNTER. A conſtellation of the northern hemiſphere, more uſually called Orion. *See* ORION.

HUZME. A name given by ſome to the bright and beautiful ſtar Arcturus; it is a falſe ſpelling of an Arabic name of the ſame ſtar.

HYADES.

* HYADES. The Greeks have adapted to this cluster of stars, which they distinguished by a peculiar name, a part of their fabulous history. It was their custom to do so with respect to those constellations which they received from the Egyptians; it was therefore no wonder they should do it by those of their own formation. They tell us, that Atlas and Pleione had fifteen daughters; seven of these, who were charged with the education of the infant Bacchus, acquitted themselves so well in that office, that they were, in reward, raised up into the heavens, and called the Pleiades; and five others, they tell us, were, from their peculiar love for their brother Hyas, called the Hyades. The young Hyas, in one of his expeditions in the woods, was killed, they tell us, by a lion, and these affectionate girls wept themselves to death: they were afterwards, in reward for their affection, raised up into the heavens, and each converted into a star; they were placed together in the constellation Taurus, and, as they died weeping, were supposed to be a rainy asterism.

Others give other accounts of their origin, they say, they were the daughters of Hyas and Bæotia, and of no kin to the Pleiades commonly supposed to be their sisters. Others, who make the Pleiades the daughters of Oceanus and Atlas, tell us, that Orion persecuted one of them to get her to consent to his desires, but that she still refused; they say they had this situation given them in the heavens on that occasion, and that Orion still seems to follow them.

They are a cluster of stars in the Bull's face, and are five in number, their situation may be seen in the description of that constellation. *See* TAURUS.

HYDRA, *or* DRACO. We meet with this constellation under a very different name among the enthusiastic reformers of the sphere. Schiller has cut off its head, and called it the body of the river Jordan. *See* DRACO.

HYDRIA. A name by which some, who are fond of uncommon words, have called the constellation Crater, the Cup. It is one of the old Greek names, but is now seldom heard of.

HYDRIDURUS. A name by which some have called the constellation Aquarius. We find it among some of the old Greek writers; Appian has it, and these lovers of strange words have got it.

HYDROCHOUS. A name by which some, who are fond of using uncommon words, call the constellation Aquarius. It is one of the old Greek names of this sign.

* HYDRUS, *the Water Serpent.* One of the new constellations of the southern hemisphere. It is of considerable length, but its breadth is not great, so that it contains but a small quantity of stars. The figures of the new constellations are in general better drawn, or represented more according to nature, than those of the old ones, and the case is so in this; the Dragon of the northern hemisphere and the Serpent of Ophiucus have both of them hairy heads, and other additions to the serpent-kind which are not in nature, but this is drawn without any thing monstrous about it. This however may be observed, that as some other figure might just as well have comprised the stars which form this constellation, as those of the Serpent; it would have been better, if, to avoid confusion, a creature not so nearly allied to the two Snakes of the other hemisphere had been selected.

The constellations, between and among which the Hydrus is placed, are the Toucan, the

the Peacock, the Bird of Paradiſe, the Chamelion, and the Sword Fiſh. But ſome of theſe are at a conſiderable diſtance. The head of the Hydrus is ſituated juſt under the tail of the Toucan, that is at the feet of the Phœnix and the termination of the Eridanus; it is at a conſiderable diſtance from the Sword Fiſh, but, by a great bend about the middle of its body, it comes nearer to it afterwards. The Chamelion and the Bird of Paradiſe are oppoſite, though at a conſiderable diſtance to that part of its body which is between this bird and the extremity, and the tail terminates juſt at the feet of the Peacock.

The ſtars that compoſe this long, and, as it were, ſtraggling conſtellation, are only ten. The moſt conſiderable of them all in magnitude is in the head. There is a ſingle one at ſome little diſtance below this, and a little lower two others, the one of which is alſo double, or compoſed of two ſtars. There is no ſtar from this part till after the bend of the body. There is there a ſingle and ſufficiently conſpicuous one, a little farther there is another ſingle but ſmaller, and at a ſomewhat greater diſtance another, then there is a ſpace vacant till near the tail, where there are three of them very fair and conſpicuous ſtars diſpoſed in a line, one beyond, and another at a very little diſtance.

HYPENTHERIAN. A name by which people, who are fond of hard words, call the conſtellation Aquarius; it is the Coptic name of that ſign, and in that language ſignifies Brachium Beneficii.

HYPERBOLA. A figure made by the cutting through a part of a cone with a plane inclined in ſuch a manner to one of the ſides of the cone, that, if the plane and the ſide were extended both ways from the baſe of the cone, they would meet in a point above the vertex of it. *See* CONE.

HYPOCYRRUS. A name given by ſome to the great ſtar in the Bull's eye called Aldebaran.

HYPOTENUSE. Where a triangle is right-angled the ſide oppoſite to the right angle is always the longeſt, and this is called the Hypotenuſe. The other two ſides are, in this caſe, the legs, and in every ſuch triangle the ſquare of the Hypotenuſe is equal to the ſquares of the legs, or the ſquare of the longeſt ſide is equal to the ſquares of the ſhort ones. When aſtronomers would expreſs this in few words, they ſay the Hypotenuſe is equal in power to the legs. This is of vaſt uſe in Trigonometry, for by it the meaſure of any right-angled triangle is eaſily found, if we have any data to go upon. Thus, in every right-angled triangle, if one acute angle and the length of one ſide be given, the whole triangle may be known, or we may find the quantity of every angle, and of every ſide.

HYRIDES, OR HYRIADES. A name by which ſome, who love hard words, call the conſtellation Orion. Ovid gives the reaſon for this, Hyreus, he tell us, was the father of Orion.

I.

JACOB. According to Schiller, and the rest of the reformers of the sphere, one of the constellations of the southern hemisphere. They have arranged the stars of both the hemispheres into sets of new constellations, and out of those which form the Wolf in the old astronomy, they have made the figure of this patriarch. Just by him are placed Abraham and Isaac, whose figures are made out of the stars of the Centaur.

Jacob is also a name with some of one of the northern constellations Auriga. Schickard and Hartsdorf, with some others of the same turn, became scandalized at pagan names given to the constellations, and after they had destroyed all these, calling Perseus, David; Andromeda, Abigal, and so of the others; they proceeded to adapt some scripture name also to every human figure which they saw in the sphere. Thus some of them made Bootes, Jacob, but the more pious Schiller, who will not admit a patriarch among the stars while there is a saint unprovided for, calls this St. Jerom. These are authors regarded by very few.

JACOB's WAGGON. A name given by some to the Lesser Wain, or Lesser Bear. Others call it Joseph's Chariot, and Schiller altering the whole figure, makes it St. Michael.

JACOB AND ESAU. A name by which Schickard and some other fantastical people have called the constellation Gemini. These are a set of writers who would not suffer the heavens to be defiled by the pagan histories, and therefore have placed stories from the scripture in their room. The same author puts David with the head of Goliah in the place of Perseus, with that of the Medusa, and so of several others. Nothing can be so contemptible as this attempt of new-modelling the constellations to keep out pagan superstition, but Schiller has done more in it than even Schickard: he has gone so far as to place the twelve Apostles in the stead of the twelve succeeding signs of the zodiac. The Ram gives place to St. Peter, and St. Andrew stands for the Bull; and so of the rest. This was playing the same piece of artifice upon the Greeks, that they had before played upon the Egyptians. The constellations were the origin of that country, and it was from thence that the Greeks, at and about the time of Thales, obtained them from the priests: but although they borrowed the knowledge from that people, they had an ambition that those who received it from them should suppose it original to them and their own; they knew no way so likely to effect this as the adapting their history, or their fable, to the several figures, and this they did. The kneeling man they called Hercules, the other human figures they named Perseus, Andromeda, Cepheus, Cassiopeia,

peia, and by other names belonging to their hiſtory or their fable, and the conſequence was what they had expected, and what they intended. Many of the leſs informed countries, into which they carried the ſcience, would, as of their own invention, receive conſtellations, the very figures of which did, as they imagined, refer to their hiſtory; and conſequently the origin of the conſtellations was underſtood to be no earlier than the Grecian learning. Theſe honeſt Chriſtians had certainly no deſign of this diſingenuous kind, but, without their fault, the effect would have been the ſame, for commentators of ſome future period, if this later ſyſtem ſhould have taken place of the elder, would have determined, that the formation of the conſtellations could be no earlier than the time of Chriſtianity, becauſe the apoſtles and ſaints of that church made the ſigns.

JAMES, *or* St. James *the* Younger. A name given by an enthuſiaſtic ſet of writers to the conſtellation Virgo. Schiller is at the head of theſe; he had determined to raiſe the twelve apoſtles, by a new way, into the ſkies, and he placed them as the twelve ſigns of the zodiac, arranging the ſtars under the lineaments of an human form, which he called by one or other of their names; Aries became St. Peter, the Bull St. Andrew, the Lion St. Thomas, and ſo of the reſt. Schickard has all the pious folly of this writer, and grieves that the heavens ſhould be made the regiſters of falſehood and of folly; he attempts the getting rid of the heathen fables however in a gentler way. He had the diſcretion to know that the placing new figures for the ſeveral conſtellations, would be giving up a great part of the advantage from the old aſtronomy, he therefore retains the figures as they are, and, as the Greeks ſerved the Egyptians, he is for having us ſerve the Greeks. Thus the Lion, which, with the Egyptians, ſerved only as a ſymbol or hieroglyphic to expreſs the ſun's great heat, the Greeks made to be the figure of their Nemæan Lion, and to have fallen from the moon; ſo they made a figure, which they found ready formed in the ſkies, commemorate one of the labours of their Hercules. Schickard deſires the Lion may be, by us, underſtood to repreſent the Lion of the tribe of Judah; and on the ſame plan, without altering the figure of the conſtellation Virgo, as Schiller does, who converts it into his younger James, this author deſires it may ſtand as a virgin ſtill, only being ſuppoſed to repreſent the Virgin Mary. This is leſs miſchievous than the other innovation, but it is not at all leſs fooliſh. We receive the figures in the heavens as of no uſe but to mark the places of the ſtars, and as they were formed in pagan times we muſt be content with the alluſion to ſtories that we deſpiſe. To alter them is to throw away the aſſiſtance of all early obſervations.

JAMES, *or* St. James *the* Elder. A name given by Schiller and his followers to the third ſign of the zodiac. He has placed the figure of this ſaint in the place of the conſtellation Gemini, and arranged its ſtars under a ſingle figure. *See* Gemini.

JASION. A name by which ſome of the Greeks have called the conſtellation Gemini, or a part of it. They ſuppoſe the two figures Triptolemus and Jaſion.

ICLIL, *or* Al Iclil. A name by which ſome, who are fond of obſcure words, have called the conſtellation Corona Borealis, or the Northern Crown. It is one of its Arabic names, and the word, in that language, ſignifies a crown. They call it alſo Al Pheccea Apertio.

JEROM, *or* St. Jerom. A name by which Schiller has called the conſtellation Bootes. Others, of the ſame enthuſiaſtic turn, have called it Jacob. *See* Bootes.

IMMERSIONS. A term uſed by aſtronomers who have written concerning the ſatellites of Jupiter and Saturn, to expreſs their entering the diſk of the planet when their courſe in their orbits, with reſpect to us, carries them through that part of the heavens which is occupied by the body of their primary planet. The term emerſions is uſed for their leaving the body of the planet again. With regard to the ſatellites of Jupiter we ſee very diſtinctly theſe immerſions and emerſions, and uſe them in computation; but with reſpect to Saturn, his ſatellites appear ſo much ſmaller, and, when near the body of the planet, are ſeen ſo much leſs diſtinctly than thoſe of Jupiter, that we do not at all diſtinguiſh theſe immerſions or emerſions; nor is this a wonder, for the two firſt ſatellites of Saturn are, in a great part of their courſe, inviſible.

INDEFINITE. Aſtronomy adopts this term from the mathematics, and expreſſes by it extent not circumſcribed by bounds. Thus a line extended both ways without limitation is an indefinite line, a ſurface ſo extended is an indefinite ſurface, and ſo of the reſt. Some expreſs the ſame meaning by the term infinite, but that is leſs proper.

INDIAN. One of the conſtellations of the ſouthern hemiſphere. *See the article* Indus.

INDIAN BIRD. A name for one of the new conſtellations of the ſouthern hemiſphere which is ſituated not very far from the ſouth pole, reaching from the Chamelion and the Triangle, and containing eleven ſtars. It is called alſo Avis India, and Apus. *See the article* Apus.

INDUS, *the Indian.* A conſtellation of the ſouthern hemiſphere. It is one of the new-formed ſigns, and the name of it therefore is not to be expected in the old writers. The Indian is but a ſmall conſtellation, and it does not compriſe more ſtars than are proportioned to the ſpace which it occupies in the heavens. It is repreſented in form of a naked man with an arrow in one of his hands, and three more under the other arm.

The conſtellations, between and among which the Indian is placed, are the Toucan, the Crane, the Peacock, and, at a greater diſtance, the ſign Sagittary and the Hydrus. The beak of the Toucan comes toward his thigh, the wing of the Crane is at a ſmall diſtance from the feathered ends of the three arrows that are under his arm, and the lower part of his figure is, in a great meaſure, hid behind the breaſt of the Peacock. The ſign Sagittary is at a diſtance over the arm that holds out the ſingle arrow; and the Hydrus is alſo at a diſtance on the oppoſite ſide.

The ſtars, which are accounted to the conſtellation Indus, are twelve, ſome of them are tolerably large, but they are not diſpoſed ſo happily for marking the figure as in many of the conſtellations. There is a ſmall one toward the head of the arrow which he holds in his hand, and a much larger toward the feathered part, and there are three others oppoſite, one in the feathered part of each of the arrows that are under his other arm. There is one ſtar on the face of the Indian toward the lower part; on one of his ſhoulders there is alſo a ſingle ſtar, and there are two on the other ſmaller, and very near to one another. There is one larger on his breaſt, and one on his belly juſt above the belt, and one in the breaſt of the Peacock that

is

is alſo common to the thigh of the Indian, the lower part of this figure being hid behind that conſtellation. There is another conſiderable ſtar alſo on the breaſt of the Peacock, which, if it be made to belong to the Indian, will fall ſomewhere about the other thigh. Upon the whole, the conſtellation Indus, though not extremely well marked as to the out-line of the figure, yet contains ſtars ſo particularly ſituated with reſpect to one another, that they are eaſily known.

INFORM STARS. A term by which ſome expreſs what others, in general, call the unformed ſtars in the heavens, ſuch as are not taken into any conſtellation. *See the article* UNFORMED STARS.

INFORTUNA MAJOR. A name we find the planet Saturn called by in the writings of thoſe who love obſcurity. It is a name that occurs among the Latin writers, and ſeems derived from ſome of the old Greek ones. Some called it Stella Tremeſcoſa.

INFORTUNA MINOR. A name by which many, who affect to uſe uncommon terms, have called the planet Mars. As they call Saturn Infortuna Major, the notion was very early that the planets had an influence upon human actions, and the events of things, particularly in certain aſpects with the conſtellations; and they thought ſome of them in general bad, and ſome good in their preſages. Jupiter was among the number of the good, and he was the firſt of them; Mars was the ſecond of the unfavourable, he and Saturn being the two moſt ſcandalized.

INGENICULUS. A name by which ſome of the Latin writers have called the conſtellation Hercules.

INNOCENTS. According to ſome, a name of one of the northern conſtellations. Schiller is the author of theſe innovations; out of patience with the Heſperian Dragon, the figure and ſtory of which was ſuppoſed to be preſerved in the conſtellation Draco, he has drawn a parcel of children, whom he calls the innocents deſtroyed by Herod, in its place. Schickard is much more pardonable, he lets the figure remain as it is, and only deſires, that, inſtead of the Heſperian Dragon, it may be called the Infernal Dragon, or Draco Infernus. To this the ſcience has no objection.

JOACHIM AND ANNA, *or* ST. JOACHIM *and* ANNA. A name given by Schiller to the conſtellation Cetus, or to a conſtellation which he has formed out of the ſame ſtars and put in its place. Schickard calls it Jonas's Whale; but all this is idle and ridiculous.

JOB. According to Schiller, one of the conſtellations of the ſouthern hemiſphere. This author, after he has demoliſhed all the conſtellations, affects the new arranging the ſtars, of which they are compoſed, under ſuch other figures as pleaſe him.

JOHN, *or* ST. JOHN *the* BAPTIST. A name of one of the ſigns of the zodiac. Schiller, and ſome other enthuſiaſtic people, ſcandalized at the heathen figures in the heavens, diſplaced them all, and put ſaints, martyrs, and apoſtles in their room. St. John, according to theſe gentlemen, occupies that part of the zodiac which others aſſign to the Crab. *See* CANCER.

JOHN BAPTIST. According to ſome writers a name alſo of the planet Venus. This is

a part of the jargon and nonſenſe introduced, or attempted to be introduced into aſtronomy by Schiller. When he had new modelled all the conſtellations he began to new name the planets. Saturn he calls Adam, Jupiter is Moſes, and Mars Joſhua, the Sun is Jeſus Chriſt, the Moon the Virgin Mary, and Venus and Mercury are St. John Baptiſt and Elias. It is well this enthuſiaſm never got ground. As to the new naming the planets, there would have been no great matter, but the naming the conſtellations a-new would have been the cauſe of endleſs confuſion.

JONATHAN's ARROW. A name given by Schickard to the conſtellation Sagitta. This author leaves the conſtellations in figure as they are, but he adapts ſome ſcripture incident to them. Schiller takes greater liberties, he turns this into the lance and nails that wounded our Saviour.

JONAS's WHALE. A name given by Schickard to the conſtellation Cetus. Schiller has new modelled it, and calls it by the name of a couple of ſaints, St. Joachim and St. Anna.

JOPHERUD. A name by which ſome, who are fond of uncommon words, have called the conſtellation Cygnus; it is the Perſian name of that ſign, and ſignifies a bird.

JORDAN, *or the River Jordan.* A name of one of the conſtellations according to Schiller. He has cut off the head of the Hydra, and has formed the body of that ſerpent into the courſe of the river, which he calls by the ſcripture name Jordan.

JOSEPH, *or* St. Joseph. A name of the conſtellation Orion. Schiller gave it this denomination. Schickard deſires that it may be called Joſhua, but people have not much minded either of them. We find it called Orion as it uſed to be.

JOSEPH's CHARIOT. A name given by ſome to the Leſſer Wain, or Urſa Minor; others calls it Jacob's Waggon, and Schiller alters the figure, and makes it a St. Michael.

JOSEPH's CUP. A name given by Schickard to the conſtellation Crater, on the back of Hydra.

JOSHUA. A name by which ſome have called the planet Jupiter. Schiller firſt gave it this appellation. After he had demoliſhed all the pagan conſtellations, he began with the name of the planets. Saturn he calls Adam, Mercury Elias, Jupiter Mars, and Venus St. John Baptiſt.

Joſhua is a name given by Schickard, and continued by his followers, but they are not many, to the conſtellation Orion. Schiller calls it Joſeph and St. Joſeph.

IRRATIONAL QUANTITIES, *called alſo* Incommensurable Quantities. Such as have no common meaſure that can be applied to both. *See* Quantities Commensurable.

ISHA. A name by which ſome have called the conſtellation Andromeda. It is the firſt word only of the Hebrew name of the ſame conſtellation. The whole term is Iſha Shalahajala Baal. The plain interpretation of which is a woman wanting an huſband.

ISIAS. A name given by ſome to the conſtellation Scorpio. It is the Coptic name of that ſign, and it is made to expreſs in that language Statio Iſidis.

ISIS, *Star of.* A name by which we find the planet Venus called in the Egyptian aſtronomy. They called Jupiter the ſtar of Oſiris, giving the two brighteſt and greateſt planets the names of theſe their reverenced deities. Venus has by ſome alſo been called the ſtar of Juno. The Egyptians worſhipped the moon under this name, ſometimes as a male, and ſometimes as a female deity: they alſo worſhipped the ſtar Syrius under the ſame name, but that only as a male.

JUDAH's LION. A name which Schickard has given to the conſtellation Leo, the fifth ſign of the zodiac. We may very well pardon enthuſiaſm when it goes no farther than this; but when it comes to alter the figures, it is out of its province, and diſturbs a ſcience. Let the Lion be a lion ſtill in form, and we may permit theſe gentlemen to call it what they pleaſe; but it is an unpardonable folly in Schiller, another of theſe writers, to have altered all the figures. This writer has placed the twelve apoſtles in the zodiac, and St. Thomas ſtands in the ſpace occupied by Leo. This however was too wild a deſign to be countenanced.

JUDE, *or* ST. JUDE. The name of one of the twelve ſigns of the zodiac, according to ſome enthuſiaſtic writers on aſtronomy. Schiller is one of the principal of theſe. He has diſplaced all the old figures from the heavens, and has put the twelve apoſtles in the place of the twelve ſigns of the zodiac. His St. Jude is that which all the other writers in the world call Aquarius. There have been others who have aimed at reconciling ſome part of the ſtory of the Old Teſtament to all theſe paſſages, and they have made this conſtellation Naaman; but it is abſurd and idle. We receive theſe figures in the heavens as proper forms for aſcertaining the places of the fixed ſtars with reſpect to one another; and we mean no more by them; we reject and deſpiſe the hiſtories and fables that are annexed to them; and to introduce new ones is to create confuſion, and to take away the uſe of the old obſervations. *For the account of the ſtars in Aquarius, ſee* AQUARIUS.

* JUDICIAL ASTROLOGY. Aſtrology is a term that has been, at various periods, uſed in very different ſenſes, having by ſome been made ſynonymous with the word aſtronomy, and underſtood to expreſs a very honourable ſcience; and by others ſeparated quite in its ſignification, and uſed to expreſs what we more generally ſignify by the name of judicial aſtrology; a ſcience, or pretended ſcience, which from the ſituations of the ſtars, and their imaginary influences, foretells events.

If we meet with the word aſtrology in antient writings, we are to underſtand by it moſt frequently no other than aſtronomy; but when it is uſed by the moderns, it generally is intended to ſignify preſages from the ſtars, and not the knowledge of their motions.

It will not appear a wonder that the antients confounded aſtronomy and aſtrology together, if we conſider, that with them they were naturally one ſcience, though at preſent ever ſo diſtinct. The firſt notices that were taken of the ſtars were that their riſing and ſetting, preſaged, as they underſtood it, certainly, they preceeded rains, ſtorms, or fair weather. Nothing was ſo natural as to ſuppoſe, that they had ſome ſhare in the cauſing what followed ſo conſtantly their appearance; and from this imaginary effect upon the air and elements, the tranſition was eaſy to the ſuppoſing they had the ſame effect upon the human body, and from this, with the mixt prognoſtications that followed, aroſe the whole of that imaginary ſcience.

That

That aſtrology was thus early blended with aſtronomy, appears from the earlieſt accounts. We hear of the Chaldæans as the firſt aſtronomers; we have records of their obſervations, which countenance the belief of their having a title to this honour; and we find the Chaldæans as early celebrated as ſoothſayers and vizards. Even the ſcriptures mention them under that character. Aſtronomy, at leaſt what we at this time underſtand by the word, is far from an old ſcience. The Greeks were the firſt who began to apply geometry to the heavenly obſervations, and Thales (the firſt who introduced any regard to the ſcience among them) was not more than five or ſix hundred years earlier than our Saviour. This may appear a period at ſome diſtance, but when we reſpect the origin of ſciences we look deeper, and we ſhall find much earlier mention of a knowledge of the ſtars than this. Thales had his knowledge from Egypt. The conſtellations had been known in Egypt very long before his time, and there is proof that the very ſigns of the zodiac, which probably were not the earlieſt of them, were not of Egyptian origin, for they refer to ſeaſons, as thoſe ſeaſons occur in other countries, but not as they happen in that ſingular kingdom. Virgo ſignified the harveſt ſeaſon approaching; the ripe ear of corn in her hand ſhews it; and autumn, the ſeaſon when the ſun enters into Virgo, is the harveſt-time of other countries; but March and April are the harveſt-months of Egypt. In the ſame manner Aquarius, pouring water out of his urn, expreſſed the rains of winter. But in Egypt their is no rain, nor hardly any winter; for the months of December and January are the fineſt of the year. It is evident from this, that the Egyptians, who brought the knowledge of the conſtellations to all other people, brought them from elſewhere themſelves. This will ſhew us a very early period of aſtronomy. Probably its æra is to be dated from ſoon after the flood; and this early aſtronomy we ſhall as certainly find connected with aſtrology, as the ſucceeding ſcience of that name ſeparated from it.

When we find therefore the word aſtrology in the old authors, we are to underſtand by it all that was known, and all that was imagined of the ſtars: that ſcience, if it could deſerve ſuch a name, in which was comprehended all the little that was known of the nature and motions of the heavenly bodies, and the great deal that was believed of their influences. Aſtrology contained therefore, in its early ſenſe, the mixt and falſe ſcience; at preſent it is underſtood only of the falſe, as ſeparated from the true; or the judicial, as diſtinguiſhed from the other part.

It will appear too harſh to ſome to cenſure judicial aſtrology as wholly falſe. There were in the times of ignorance many who repoſed an entire confidence in it; and there are ſome in theſe days of knowledge, for knowledge, tho' general, is not univerſal, who pay ſome reſpect to its deciſions. But we ſhall find, that the opinion of its falſity is not wholly owing to, or entirely to be dated from the diviſion of the ſciences, for the men of judgment in the earlieſt ages paid no reſpect to it.

The ſtories annexed to the conſtellations by the early Greeks were known to be fabulous, too contemptible for belief; and the early writers have bantered the people who ſeemed to be juſt dropped down from among the ſtars by their perfect acquaintance with them. There were very early attempts made to eſtabliſh rules for the ſcience; but theſe being the offspring of the fancy, not the fruit of the judgment, of thoſe who ſet them on foot, were ſo inconſiſtent, and even contrary, that they overthrew one another: and it was not with-

out

out reaſon that thoſe among the antient philoſophers, who diſcountenanced its pretenſions, argued, that, from the inconſtancy and uncertainty of the art, they were convinced it was no art at all.

We know how addicted the people of the firſt ages, of which we have account, were to ſuperſtition. It is not a wonder that thoſe, who would look for the deciſions of fate in the entrails of an animal, caſt their eyes up ſtrait for it to the heavens alſo, or that men, who ſuppoſed a magpie, or a fox, by flying or running acroſs their way, had the effects of good or ill preſages upon their journey, ſhould ſuppoſe no part of their lives out of the influence or direction of ſuch ſuperior bodies.

The ſtars thus got into repute, as having influence over human events, and when they were allowed a power it could not be long before men would pretend to the underſtanding it. Where there are weak, there will alſo be deſigning men, the one are the natural prey of the other, and the carcaſſes will always draw together vultures. It was on this principle that aſtronomy itſelf was firſt ſtudied. Thoſe who beſt underſtood the motions of the ſtars, were ſuppoſed beſt acquainted with their hidden influences; and it became their intereſt to keep up the opinion of their power.

From the underſtanding, in ſome degree, the revolutions of the year, they came to preſage, at ſome diſtance, ſeaſons which always happened at ſuch parts of thoſe revolutions, and they were almoſt ſuppoſed to create the things which they foretold. The reception of thoſe attempts encouraged them to greater, and if, among a hundred conjectures, but one fell out right, the miſtakes were all forgot, and the one event that followed the preſage immortalized them. Men wiſh to find a power lodged ſomewhere of ſeeing into futurity, and what they wiſh they eaſily believe. From the influence of the ſtars, at certain times of men's lives, they began to regard thoſe at their birth with a peculiar attention, and the firſt attempts at calculation were not with reſpect to what ſhould, but to what had happened. They went back to the birth of the perſon who conſulted them about his fortune, and having found, or thought, or pretended they found, the conjunctions of the ſtars at that time, they thence told the paſt, and preſaged the events of the whole ſucceeding life.

Here was the beginning of the art of caſting nativities; and from the regard paid to the opinions founded on this, the aſtrologers were encouraged to extend their art, and the power and influence of the ſtars to every human concern. They made them intelligent beings, acquainted with all ſecrets, and pretended an acquaintance with them, by which they learned all that was known to them. Hence aſtrologers undertook to reſolve queſtions, foretel future, and explain paſt events, interpret dreams, and diſcloſe the intentions and the thoughts of others. They ſeemed, if themſelves might be believed, (and there were enough who did believe them) to be admitted into the deſigns of providence, and to be able at leaſt to foretel, if not to procure, the good events of its intendance.

To lay their art beyond the reach of every little attempter, or of every little enemy, they pretended to go back to very remote ages, and to carry their knowledge of the heavens into the remoteſt time, and to preſage events yet to happen from the great conjunctions, which they calculated to have happened many ages before the earlieſt periods of hiſtory. This was puzzling to the uninformed of the ages in which the artifice was uſed, for the ignorant cannot fix bounds to the knowledge of others; and it is to this artful attempt that aſtronomy owes its

its pretences to that early origin which we see its votaries assert. The old astrologers had their schemes of what had been the conjunctions, what the oppositions, and what the faces of the heavens, at periods far before the time of their first or remotest annals; and to these, (no matter whether true or false, for none could contradict them) perhaps, is owing the pretence of antiquity in some of those nations. The Babylonians, Chaldæans, and Egyptians, were the first astrologers, and when they had calculated the face of the heavens for such early periods, it was easy to invent kings names to answer to those periods, and thus to carry the origin of their monarchies farther back than all other people.

The late astrologers have in all things been faithful copiers of the earlier; if those pretended to calculations for times before the origin of their empires, there have been among these some who have figures of the heavens at periods before the flood; and the weak people of these times pay as much respect to these, as those among the Egyptians did to the others. From these, and their subsequent calculations, they pretend to foretel the duration of empires, and it cannot be strange that those, who can do this, make it the easiest part of their art to foretel the several accidents that are to befal particular persons.

When the sciences were in their infancy, this, which was the earliest of them, easily claimed a right even to their dependance, and its professors were not of those people who were likely to forfeit any of its pretensions. Physic was one of the next sciences studied, and the astrologers found a way to make themselves and their own art considerable at the expence of this. The influence of the heavenly bodies on the human frame was a doctrine early established, and not at this time altogether rejected; and this immediately sent the physician, as well as the sick, to the astrologer, to know under what face of the heavens he might expect most success from his medicines. Nor was this all; they pretended that the heavenly bodies diffused their influence, not only over the human frame, but equally over all sublunary productions, and that all these obtained their virtues from them. Thus the medicines, as well as those who were to be relieved by them, were thrown under the protection of the planets and fixed stars, and the virtues of plants and minerals, as well as those of animals, were supposed owing to their influence. The astrologer therefore was the true physician, and indeed there were very few of the concerns of the world that did not come immediately under his cognizance. Here was a beginning therefore of astrology that gave it pretensions to universal respect, such as no other science had ever boasted, and those, who were in possession of its advantages, did not fail to push them to the utmost. From presaging the success of an amour, or the event of an undertaking, the proficients, in this pretended science, (for still it was a fiction at the bottom) became consulted about the health, and in the common concerns of life. If a peasant lost his cow, or if he suspected that his tawny mistress was unfaithful, the same sage resolved the doubt, or pointed out the way the stray beast had taken; if he were sick, not only what physic was proper, but under what aspect it would be most efficacious was to be determined by the same mouth; and the husbandman, who had great caution, and less judgment, would not sow his corn till he knew whether the stars favoured the operation, nor cut down his harvest unless the astrologer predicted good weather.

It was in vain that the wiser people of these ages despised and censured the pretences of the artists, and rallied the credulity of those who trusted

trusted them; nay, it is in vain, that reason and religion join at this time to discountenance the folly; there always were, there are, and there always will be some to believe in it. The cheats who calculate nativities, and pretend to foreknow the events of actions at this time, all pretend to astrology as the source of their information; and they are as ignorant, and somewhat more hardened, than their predecessors. If we look among the wise men of old time, we shall find the greatest names to condemn all pretences to this art. Pythagoras, superstitious enough in some things, declares against every article of it. Democritus was the champion of a whole sect that condemned it; and Bion Favorinus, Panætius, Carneades, Possidonius, and Timæus, are all quoted as rejecting its doctrines, and condemning those who paid respect to them. Aristotle was earnest against it; and Plato has taken as much pains to destroy the credit it at that time obtained with some credulous people, as he calls them, as he would have done to overthrow a false religion. If it be supposed, that the physicians, for they have at other times been, as they are at this, a body distinguished by their learning, favoured this opinion, established by astrologers, and received by their fathers, we may produce the reverend names of Hippocrates and Galen in flat contradiction; they declare against it all; nay, not the Greek physicians only, but the Arabians, among which people the false science was received with credit, after it was rallied out of Greece, all join against it. They despise and condemn all who paid credit to it; and it would not be easy to produce more strenuous advocates against it than Avicenna and Averrhoes. Among the Latins we shall find, as among the Greeks and Arabians, some enthusiasts, but they were in one country, as well as in the others, formed among the weak, or interested people. Let us enquire into the opinions of those whom we respect among them, and we shall find they all agree in the contempt with which they treat this science. Cicero and Seneca have spoken often, and expresly of it, and both, in the most clear and strong terms, reject and condemn it. All these were persons of the most inquisitive and most disinterested turn. They have all attempted to explain the causes of things from some one or other of the sciences; but not one of them has in any place referred us to the stars for them, or understood astrology, as one of those sciences, to which it was worthy the name of a philosopher to refer. Were it their silence alone, on this head, that pleaded against their belief in such a science, this were enough; but when it is supported by that reproach and contumely with which they treat it and its professors, the proof is doubly strong, and ought to be convincing.

In what light the men of real science, among the moderns, have seen this science, as it is called, is plain enough. Nothing has been so perfectly, nor any thing so justly, an object of their contempt; but that it might not be alledged, that there had been wise men of other times, and that those men countenanced what these despise, it appeared necessary to produce this honourable list of the philosophers, and learned men of old; and it were easy to add to it almost every name of repute at this time with the world, to shew that such have never credited its pretensions; but that astrology has been at all times, as it is now, the contempt of the wise, and that all which can be alledged in its favour from early times is, that weak men did then, as weak men do still, believe it; and that knowledge having been then less diffused among the generality of mankind than it is at present, they were a greater num-

ber, whom ignorance, the natural parent of error, at that time, induced to believe it.

If it be objected, that these whose names have been already mentioned as men, who held the science in contempt, were not the most competent judges of it, because, altho' men of great wisdom, they had not in particular applied themselves to the study of the heavens; the plea is artful, but it will not serve the purpose. In the first place, these philosophers were none of them ignorant of what little was in their time known of true astronomy, therefore they were informed of whatsoever absolute and real foundation there was for the opinions of astrology; but although the objection has an unfair advantage in that, as has been already observed, astronomy and astrology were too much confounded in the early days, and they who studied the one, were the very people who favoured the other; and perhaps the greatest part of them attended to the true science only to countenance the false; yet if we look into the story, or consult the writings of the greatest among them, we shall find them far from countenancing the least part of the judicial astrology, so favoured by the less informed in the same science. If we strictly examine what is recorded of the last writings of Eudoxus of Archilaus, Cassandrus and Hoichylax, we shall find them confessing, that although the heavens and heavenly bodies were to be allowed some power and influence over human events, yet there are so many other causes of those events co-operating with them, that nothing could be presaged with any degree of certainty from their influence alone. This we find delivered as the opinion of the most moderate, and this is enough to overthrow all the pretensions of judicial astrology from antient authority; but if we enquire into the opinions of those who carried the science of astronomy to its greatest height, or made the boldest improvements and advances in it, we shall find all the credit of astrology overthrown by the contempt with which they treat it. If we respect what is said of Thales, the first among the Greeks who travelled to Egypt for improvement, and probably the father of astronomy among them, we shall find that although he brought the knowledge of the Egyptians into Greece, he held their predictions in the most perfect contempt, and that while he received, as the greatest of all treasures, their accounts of the constellations, and of the motions, so far as they had informed themselves concerning them of the moon and planets, he laughed at the pretended influence of all these bodies, and if he named it, it was but to warn men not engraft such follies on that sublime science in which he instructed them. Perhaps it is from Thales that we are to date the separation of the two sciences, for so, in compliance with vulgar opinion, we must call them, of astronomy and astrology; for devoted as he was to the study of the stars, no man appears, by the accounts we have of him, to have treated the opinion of their influence with so perfect a contempt. If we after this enquire what is said of Hipparchus, he who is celebrated in all antiquity for understanding what Pliny tell us was esteemed a work not for a man, but a God, the making a catalogue of the fixed stars, which vast undertaking he lived to execute to his immortal honour; we shall read of him as one who far from believing that the constellations, or the planets, had any effects on the actions of mankind, or that the events of enterprises, or fates of private persons, or of kingdoms, could be predicted from them, treated with the severest censure those who affected to believe such things, and held them as intentional deceivers of mankind, not to be despised but punished,

not ignorant or deluded, but wicked and designing. Ptolemy, who followed this great man at the distance of some ages, and who reverenced his sentiments, and adopted all his opinions, did not quite vary from him in this; yet living in an age of more credulity, or else being of less boldness to oppose a common folly, he does not say, that the stars have no natural influence on human bodies; but that there are so many co-operating causes, and some of them so much stronger than that influence, that therefore men are not always governed by it. This was the opinion of those earlier astronomers already mentioned, and as it was more moderate than the others, it gained ground.

Men will reason differently on the clearest principles, and often what with some will wholly overthrow, will with others tend to support the opinion. It thus happened with respect to the credit of astrology from the time of Ptolemy. What ought to have wholly discredited, has been made its strongest bulwark, and far from overthrowing it, has proved the very cause of its support, when it would otherwise have fallen by its own absurdity. Men adopted the moderate opinion of Ptolemy, and as it rendered the stars less certain in their effects, and consequently the presages from them more fabulous, it gave an excuse for all the errors of the calculators.

From this sprang the doctrine, that the stars only shewed what would naturally happen; but that this was liable to so many accidents from these co-operating causes, that it was no miracle if it were prevented; and that they did not compel men to particular actions, but only enclined them to them. Hence from an absolute, astrology became but a conditional science of prediction. Thus were all the blunders of its professors excused; and though less was now pretended and proposed from it than had been, yet something was promised, and men were, as they still are, so eager to look into futurity, that not being able to know, they would be satisfied to guess; and what astrology lost in its credit, it was repaid in its credibility. The professors of the art were rejoiced, the world was satisfied; and from this time it became a science only of probable conjecture, and therefore liable to no censure from the most unfavourable concourse of accidents.

Judicial astrology was thus, in its origin, probably Chaldæan; from thence it diffused itself over the east, and after it had been received many ages in remote countries, of whose history we have very imperfect accounts, travelled into Greece, and thence into Arabia, and into the Roman world. In all this time astronomy led it by the hand, and in all this time, altho' an idle, yet it affected to be an innocent science. But tho' it did not continue so nearly allied in its offices, as it had been to magic; it, by degrees, allied itself in its nature; and when unable to support its credit on its own foundation, it called in this assistant, and associated itself to a science (for magic also was honoured with that name) as idle, as absurd, as false, and as imaginary as itself.

From the allowed uncertainty of the presages from the stars, men began to reflect upon the very small number of them that were verified: and though they had now, for some ages, been content under the uncertainty of the theory, they at length grew dissatisfied under the great uncertainty of the practice. The world grew weary of so unsatisfactory an art, and the professors of it found their craft falling, and all their hopes of future advantage lost.

From this period a new system became advanced. The few who had the wit and the resolution to attempt to raise their drooping

profession, separated themselves from the rest of the astrologers, who had sat tamely by to see it perish, and confessed what they declared themselves very unwilling to own, but what they could not decline, as it was the only means of informing the world on what they might, and on what they might not, depend: they owned, that there was something more in astrology than was generally imagined by the world, or even understood by its professors of the ordinary rank, and that while all was uncertainty which such predicted, yet there was dependance to be placed upon the decisions of the accomplished.

From these dark expressions they proceeded to observe, that astrology was an art of the most consummate intricacy, that it had arrived at its present state of excellence from the joint labours of a number of wise persons, that all these had left in their writings rules for prediction and presages, and that all these were founded on true knowledge; but that, as occasions varied, these were in themselves all different, and that among such dissonant and contrary opinions as were to be formed by the several rules of the same event, there required somewhat more than the wit of man to know on which to fix: that among a number that appeared all different, and yet all founded on the most certain basis, allowing only for the variety of accidents, only one could be true; that he who was guided by chance, and much more he who was directed by what he would call judgment on which of these to fix, would naturally err; for that, when the science was arrived at this height, human judgment was to be no more regarded. That the truth, the most certain and unalterable truth, was among these presages; but that he alone, who had within himself an instinct of presage, such was their term, could chuse the true rule, and therefore he alone could give the true prediction.

It is not much to the credit of the age that this was received, but it was received. And from the obscure hints they had first given of this instinct, they became bold enough to confess, that it was the knowledge communicated by a dæmon; and their champion Hali has asserted, even in his writings, that unless a man was favoured by this supernatural intercourse, all the rules of the art signified nothing, and he would be dubious which opinion to adopt, and according to what rule to act, till fixing at random, he was more likely to be wrong than right. This author declared the study of the stars to be requisite to this purpose; but he roundly asserted, that without this supernatural assistance, the astrologer could never be assured of speaking truth.

This was referring the prediction to some obscure cause in the breast of the astrologer, rather than to any settled rule of the art, for this information of dæmons was a most idle and contemptible pretence; so that the art lost its credit, while enthusiasm took the place of rules. And to this opinion Ptolemy, not much to the credit of the planetary influences, also subscribes; asserting, that the science is more in the breast of the professor than in the heavens.

Thus we see this art begun in ignorance, supported by credulity, and when falling by its discovered fallacy, raising itself again on enthusiasm. A glorious origin, and a proportioned progress. The greatest advocates for it confess, we see, that in the art itself, or, in its best rules, there is not any certainty; but that these are in themselves contradictory, and are convertible any way, according to the opinion, conjecture, or whim of the astrologer, or the imaginary influence of some supernatural agent. We can have no reason in the world to believe in this pretended supernatural assistance, so the whole falls to this, that

astrology, even on the principles of the warmest and wisest patrons, is not an art at all, but is the vague conjecture of designing, or of superstitious men: some of them laughing at the fools that regard their predictions; others, from long custom, having fancied an art out of uncertainty, and while they delude others, deceiving also themselves.

We have sufficient opportunities of judging by the mere force of reason, whether there be, or ever have been, such an art. If there be such, if it be like other sciences established on certain rules, and if those, who profess, understand it; how happens it, that, from the earliest times to the present, the predictions have been full of blunders, for this is the case. A part of the world is very desirous to believe that there is such an art, and it is only from the knowledge of these errors that they have been compelled to doubt it. If there be no such art, nor the people who pretend to it do themselves know any such rules as those to which they pretend, or even believe that there are any such, is it not rashly, foolishly, wickedly, and, in defiance of providence, that they make pretences to such an art? and are not they chargeable with one or other of these censures who countenance, support, and believe them?

We have gone through the earlier history of this famous science, but they are another set of men who have, of late times, pretended to it, and we are to look with other eyes upon their operations. We shall find, even among these, some half-mad, and doating persons, eaten up with spleen, and slaves to melancholy, who are enthusiasts enough to believe themselves what they tell others. We see the effect of the hypochondriac disorders in many instances as flagrant and as extraordinary as this; and we are not to doubt but that the same force of imagination, which leads one man to imagine he is a tea-pot, or dish of meat, and keeps him in continual alarms lest he should be eaten up, or broken, should be able to persuade another that he has inward light and supernatural notices of events; or that brooding over a set of idle schemes and unmeaning figures, he shall fancy he is able to see into futurity. The same species of madness, (for this disorder is a degree of madness) that leads a man to one of these absurdities, may also lead him to the other; and if we allow that a disorder of the frame can make an astrologer, we cannot wonder that it should also make him believers. This is a concession we ought to make in favour of the unhappy, for it is most undoubted that there have been honest people, who pretended to divination, as well as weak ones, who believed in the effects of such an art.

But, with the generality of modern astrologers, it is much otherwise; they are an artful set of people, who prey upon the weak and the unwary. From devoting their whole time to the attempt, they have found a thousand artifices by which to find from people themselves those things which they pretend afterwards to have discovered. As to their predictions, they have studied a set of general terms in which to deliver them; and adding to this the obscurity with which they speak them, it is impossible but the imagination of the hearer must hereafter find some occurrence that tallies to some part of the dark presage. These people have all the art and all the obscurity of the old oracles. Whatsoever they disclose may as well be spoken to one person as another, it is weakness and credulity that apply it. But among a multitude of general presages delivered without time or circumstance, when something, that may be forced to the meaning of some part, has happened, all the rest is expected. The credit of the astrologer is established,

bliſhed, and every thing elſe is expected. The art is ſo little in the deceiver, that it is more ſhame to be deceived.

The applications of dreams are not more vague, or more idle, than theſe predictions. The ſtory of the aſtrologer dwells upon the mind juſt like the viſion of the pillow. There is nothing that the perſon knows to which either bears the leaſt analogy, nor poſſibly ever may happen any thing to which either has but the moſt remote reſemblance: if ſo, the one and the other are forgot. But if at any time after an event happens, at all reſembling either, the dream is out, and the prediction is fulfilled, and there is juſt as much room for one obſervation as the other. The poſitions of the ſtars, with reſpect to one another, muſt be innumerable, and of theſe the obſerver judges not by any ſettled principle, but juſt as he pleaſes. He ſhews his ſcheme, and he makes it mean whatever he has a mind to ſay. After this, if the heavens do not tell truth, he cannot help it, and the old excuſe is always at hand, that the ſtars do not compel, but only incline men to thoſe actions, the events of which they foreſhew.

It is not difficult, from a few minutes converſation with a man, to know what is his predominant paſſion; at leaſt thoſe, who apply to conjurers, are ſo little upon their guard, or have ſo little judgment to guard them, that it is not difficult to do it; and from this the principal events and occurrences of a man's paſt as well as future life may be, without conjuring, known in the general; and it is only in general terms the aſtrologer, with all his pretended aſſiſtance from the ſtars, deſcribes them. In private families diſſentions and diſquiets, which are only foretold, are occaſioned by the very foretelling; and when princes have been ſo credulous as to give way to theſe infatuations, the lives of millions have been

ſacrificed, and empires have been overthrown, by thoſe things being ſuggeſted which ſeemed foretold. That there is no truth in the art is palpable, but even if there were, it would be unſafe to encourage it: in all countries it is forbidden, but notwithſtanding it is practiſed in all countries; and while there are fools enough to believe in it, there will not want people deſperate enough to practiſe it. We find them rooted out by the laws of all countries, and yet ſkulking about in all. Tacitus, ſpeaking of them with all the cenſure which it is poſſible for words to convey, obſerves, that they were forbidden by the laws to exerciſe their art in Rome, but that no power would ever be of force to ſuch a purpoſe: and as it was in Rome, ſo it is in London. The laws are in force againſt them, and the opinion of all people of common ſenſe is ſo much againſt them, that laws, one would think, might be unneceſſary; yet we meet with their bills in the ſtreets, and their advertiſements in the public papers; and it is no longer ſince than during the time of the laſt lottery, that one of them ſold his advice about the lucky numbers. There is all that can be in reaſon againſt the leaſt credit being paid to the ſcience, as they call it, but there are two principles in its favour, which are very often too powerful for the reaſon, timidity and credulity. Men run to theſe imaginary wiſe people to be aſſured of what they hope, and guarded againſt what they fear, and they take their word for aſſurance. It is pity thoſe, who will accept ſuch eaſy terms, ſhould ever be refuſed the conſolation.

It is to the common intereſt of mankind that the whole ſhould be known for impoſition, ſince to credit it is to be unhappy. The people, who place a firm belief in theſe predictions, are not very numerous, but, of all mankind, they are the moſt wretched. Eager

to

to know, or to be made to believe that they know what is to happen; and when they are informed of it, miserable till it does happen; expecting it probably in vain their whole lives, and forfeiting every rational prospect to these ideal ones. If those among our own people, who pay credit to the predictions of the worst of all foretellers of events, (for certainly those at present among us are the very worst and meanest that any age or country ever saw) would open their eyes to conviction, and look into the fate of those who had trusted to the best, they will find them all unfortunate in the end; and what is much more to the immediate purpose, they would find the most unfortunate events of their lives to have arisen from this very source. If we examine scripture-history we shall find Pharaoh and Nebuchadnezzar trusting in the soothsayers and magicians of their times, and we see the consequences. Cæsar is a fatal instance among the pagan heroes, and we may add to his name those of Crassus, Pompey, Nero, and Julian the apostate, all credulous in the greatest degree in divination, all led into destruction by the faith they had placed in the false predictions. Pompey, Cæsar, and Crassus, were all to die in their beds at a good old age, applauded by their country, and full of glory; but every one of them found the promise false. In this, however, the astrologer shares the favourable lot of the physician, the dead find no fault on the one hand, as they tell no tales on the other.

If there were any truth in their prognostications, there must first be certainty in the principles on which they found them; but if we look into the writings of the several allowed masters of the science, we shall find, as has been already observed, all the rules different in one from what they appear in another; and to come to what was intended in this place, we shall find the very properties of their several houses, from the qualities of which they all agree that every thing is to be deduced, differently described by the several writers. Ptolemy gives them one way, and Heliodorus another, and so every one beside. Porphiry says one thing of them, and Abenragel another; and even the opinions differ according to the countries, for the Egyptians had one opinion of them, the Arabians another. The Greeks explained them one way, the Romans another, and the moderns, of whatsoever nation, differently from them all. Neither are the very spaces and extent of these houses to be determined; Ptolemy giving them one way, and his several followers in the general, yet in this differing from him, and giving them some one way, and some another, and indeed each according to his own fancy.

Their rules for determining of nativities from conjunctions are not less irregular; and if we were not to laugh at the absurdity, we should, in some cases, shudder at their impiety, for they take all the power out of the hands of God, and give it to these conjunctions. When Saturn and Gemini, Mercury and Aquarius, get into conjunction, (these are the very words of one of the principal of them) then a prophet is to be born; and they go so far as to tell you that these conjunctions happened at the birth of our Saviour, and that therefore he was the greatest of all prophets. A conjunction of Jupiter and Saturn, they say, gave origin to the religion of the Jews, for all religions they derive from these conjunctions, and Jupiter is always to be one of the objects. Jupiter in conjunction with Mars, they say, gave birth to the religion of the Chaldæans; Jupiter with the sun, to that of the Egyptians; and Jupiter with Venus, to that of the Turks. Can any thing be equally ridiculous to this! to what principles would it refer the most important

portant things, and what would it make of men but a ſet of machines like puppets actuated by the wires of ſtarry influence? What becomes of the attributes of God, what of the free-will of man, by ſuch ſuppoſitions? or what regard can we be expected to pay to religion, if ſomething elſe, and not that being which is the object of it, have the care of our concerns?

It has been neceſſary to be large and expreſs on this head, becauſe there are ſtill among us too many who pay credit to the fraud or ignorance of the pretenders to this art. We ſee that reaſon and experience, the dead and the living, the teſtimonies of hiſtory, and the opinions of wiſe and of good men in all ages, agree in rooting out the opinion, and declaring art itſelf a pretence, and all thoſe bubbles who put any faith in it. Leſs than this might not have been ſufficient to diſcountenance it; all this may perhaps be too little to effect that, but, in a work intended to be uſeful as well as entertaining, no part of the argument, on ſuch an occaſion, could be omitted.

Having thus condemned aſtrology to infamy, there remains ſomething to be ſaid in favour of ſome who have been called aſtrologers; not of thoſe who at this time aſſume the name, for they are, without one exception, contemptible or odious, enthuſiaſts or cheats. But among thoſe who have been weak enough to give ſome credit to the ſcience in earlier time, we ſhall meet with ſome that deſerve a very different treatment. There is great difference between the characters of thoſe who have been miſled, and thoſe who intend to miſlead; and though ignorance, in the preſent improved times, is hardly pardonable in thoſe who make but the leaſt pretenſions to ſcience, yet, in earlier days, ignorance was to be pitied, not condemned, in thoſe who pretended moſt to them, becauſe knowledge was not yet come to them.

As Boerhaave ſays of the ſearchers after the philoſophers ſtone, the alchemiſts, that he finds more real knowledge and better experiments, and more faithful accounts of them in their works, however wrong their purſuit was, than thoſe of any other writers whatſoever on the ſubject: ſo we may pronounce upon the aſtrologers, as they are called, nay, and as they have called themſelves, of certain periods, that while we deſpiſe their opinions of the influences of the ſtars, or of the poſſibility of making preſages from them, as thoroughly as all men of reaſon do the pretenſions of the others to making gold, or diſcovering an univerſal medicine, yet as there is much knowledge in the works of the one, ſo there alſo is in the obſervations of the other; and we ſhall find many things recorded and preſerved in their writings, of which there remain not the leaſt notices in any other. Thus the different colours of certain of the fixed ſtars is a point of curioſity, preſerved no where but in their writings, or thoſe who have copied it from them; and there are many more ſuch, and ſome of uſe, which have done more honour than they ought to thoſe who copied them, and concealed the obligation; accounts of which will be found in the ſucceeding parts of this work.

It will not indeed appear ſurpriſing that the firſt diſcoveries of aſtronomy are to be found among aſtrologers, for the firſt aſtronomers were all of this claſs; and as the ſtars were conſulted on account of their imaginary influences, thoſe who put confidence in theſe imaginary powers were they who diſcovered them. We know the Chaldæans ſtudied the ſtars with this deſign, and ſcarce with any other. Theſe were the firſt aſtronomers of whom we have any diſtinct account: they were aſſiduous and careful, they had a clear air and an open country, and they, doubtleſs, made

made many, and those important as well as curious discoveries. Some of these travelled into Greece, and from thence into the rest of the world; a great part have been preserved only among the writings of those who regarded the influences, and neglected the laws and motions, of the stars, and these we find only in the writings of professed astrologers.

JUGULA. A name by which some, who love uncommon words, have called the constellation Orion; it is no new name, for we find it in use among the antient Romans. Plautus and Varro both mention a constellation under the name of Jugula, and mean Orion.

JUGULÆ. A name by which Manilius, and some other of the Latin astronomers, call the two stars in Cancer, commonly named Aselli.

JUGUM. A name by which some of the Latin writers have called the constellation Libra. Cicero has used this name for it, and it seems to be the close translation of the Greek name Zygos.

JUNO, *Star of.* A name by which we find some of the old astronomers calling the planet Venus.

JUNONIS STELLA. Is also a name by which some, who love uncommon words, call the planet Venus; it is a translation of one of the old Greek names, which was the star of Juno.

* JUPITER. The second of the planets, or the most remote of all, except Saturn, from the sun. When we see Jupiter in the heavens, he is easily distinguished from all the other stars, by his peculiar magnitude and light. He appears, of all the heavenly bodies, after the sun and moon, next to Venus, the largest, and, for a planet, the brightest. Saturn being much nearer to us, he appears much larger for that reason, and he looks less than Venus, though she is much smaller than him, only much nearer to the sun and to us.

The planets have not that brilliant lustre of the fixed stars; their light is more placid, but it is very clear and fine, and Jupiter, next to Venus, is the brightest of them all. If he wants the peculiar splendor of that near planet, he is not dead like Saturn, or ruddy and duskish like Mars, but clear, white, and fair. Jupiter will be thus known at sight in the heavens, but those who are not acquainted with his distance from the earth, will have little guess as to what kind of body it is that shews itself to them in the form of this lucid spangle. The earth is eighty-two millions of miles distant from the sun, but what is this to the distance of that planet? Jupiter is four hundred and twenty-six millions of miles distant from the sun, and as he revolves round the sun, as well as the earth does, it is easy to see what must be his distance from the earth. The disproportion of Jupiter to the earth in size, is also great; we look upon him as a little body at that distance, but the quantity or solid contents of his globe are almost nine hundred times greater, that is, in absolute words, Jupiter is eight hundred and ninety-nine times larger than this earth, his surface is equal to ninety-three times the surface of the earth, and his diameter is between nine and ten times as great. The revolution of a planet round the sun makes the year of that planet, and it is proportioned to the distance of the planet from the sun, that is to the extent of its orbit,

and its degree of motion. The revolution of the earth round the ſun is performed in three hundred and ſixty-five days and a quarter, but that of Jupiter takes up four thouſand three hundred and thirty two days and an half, ſo that the year of Jupiter is equal to about twelve of our years.

Jupiter is the faireſt of all the planets, and, according to the uſual diſtinction into ſuperior and inferior, he is one of the three ſuperior, being beyond the earth, and not between the earth and the ſun; his place is between that of Saturn and Mars. Beſide the revolution round the ſun, the planets, in general, have a revolution round their own axis, a motion like that of a bowl along a green, where all the time that it is running to the mark it is alſo turning round upon its own axis. Saturn is ſuppoſed to want this, but all that ought to be believed of this is, that he is too diſtant for us to be able to make it out; all the reſt of the planets have this, nay, and the ſun himſelf, and many, if not all, of the fixed ſtars. Jupiter has this very viſibly and very quick, it is performed in ſomewhat leſs than ten hours.

Jupiter, as remoter from the ſun, and as a larger globe than ours, will neceſſarily have occaſion for more light reflected upon his ſurface; accordingly, inſtead of our ſingle ſatellite, which we call the moon, Jupiter has four ſatellites, or four moons, placed at different diſtances from his ſurface, and performing their revolutions round his body in different periods of time. All theſe, as our moon with the earth, are carried round the ſun with Jupiter. Theſe eclipſe one another, and are eclipſed by the body of the planet; and the planet itſelf alſo is ſubject to eclipſes; he is ſometimes eclipſed by the moon, ſometimes by the ſun, and he may be eclipſed even by Mars as will eaſily appear on conſidering the places of the earth, Mars, and Jupiter. This depends alſo on the diſtance of Mars from Jupiter. It might occur to an unaccuſtomed reader that in the ſame manner as Jupiter, which is beyond Mars in the ſyſtem, may be eclipſed by Mars, ſo Saturn, being beyond Jupiter, might be eclipſed by Jupiter; but we muſt have recourſe to their magnitudes as well as their ſituation to determine this. On computation it will appear that Saturn could not be eclipſed by Jupiter, unleſs Jupiter's diameter were half as big as that of the ſun, but this is by no means the caſe; vaſt as Jupiter is, it is not one ninth part ſo big as the ſun, and therefore ſuch an eclipſe cannot happen.

It will eaſily be underſtood, that a planet placed with regard to the earth and ſun as Jupiter is, muſt come, at times, into conjunction and into oppoſition with the ſun. In the oppoſitions to the ſun Jupiter is much nearer to the earth than in the conjunctions, and this is the reaſon of the planets appearing much more luminous, as well as much larger, at thoſe times than at others.

The globe of Jupiter, viewed through teleſcopes of great power, and under the proper opportunities, appears very nearly, but not abſolutely, round; it is a little longer eaſt and weſt than it is north and ſouth, but this is ſo little that it may be very well underſtood as a round body. After Saturn, Jupiter was the object which firſt employed the teleſcope. Galileo ſoon perceived, by the aſſiſtance of that inſtrument, that the whole ſurface of Jupiter was not equally bright; he diſtinguiſhed certain bands, or, as he and all ſince have called them, belts of a duſkier colour than the reſt of the ſurface, running parallel to one another, and that according to the direction of the courſe of the planet in its proper motion.

The belts of Jupiter, ſeen thus early, have been confirmed by all aſtronomers ſince, but their number does not at all times appear the

ſame.

ſame. We generally ſee three of them by a common refracting teleſcope of ten or twelve feet. I have often uſed one of thirty-five feet without diſtinguiſhing any more. Sometimes we ſee only one, and at others there have been ſeen as many as eight. The belt, which is always one of the number viſible, and which is always the ſingle one when there is no more, is broader than any of the others, and its ſituation is on the north part of the diſk of the planet, but very near to its centre. This is the reſult of general obſervations on Jupiter, but the moſt accurate go farther. If the accuſtomed eye continues its obſervations and examination for ſome time, the changes in the belts will be found to come on occaſionally, and not only theſe but others. The three belts (for that is the quantity uſually ſeen) will become more and leſs bright at times, either throughout, or on a part of their ſurfaces, and the changes will happen more frequently in the two narrower belts; but they will be more perceptible when they do happen in the larger. If the reſt of the ſurface of the planet be alſo carefully attended to, and the teleſcope a powerful one, there will be found changes in that; ſeveral tracts of it will, at times, appear darker than the reſt, and occaſionally there will be ſeen ſpecks of a luſtre ſuperior to the reſt. Theſe, in a great degree, reſemble the tops of eminences which we ſee in the moon, and call rocks and mountains. Caſſini firſt obſerved them, and he ſays they are like thoſe peculiarly lucid ſpots which occaſionally appear on the ſun's diſk, but they have nothing of that glare; the light is bright, but it is placid.

We are obliged to the obſerver, juſt mentioned, alſo for the firſt obſervation of a moveable ſpot in Jupiter. This he diſcovered on the moſt norther part of the ſouthern belt, and he purſued its motion, which he found to be from eaſt to weſt, on the apparent diſk of the planet. When he had loſt ſight of this for a time, it appeared again, and he found it at the very ſame point where he had firſt ſeen it, at the diſtance of ten hours all but four minutes. This was not a diſcovery to be trifled with; he purſued his obſervation for no leſs than twelve months, and he always found the ſame ſpot return to the ſame place, at the diſtance of nine hours and fifty-ſix minutes, as at firſt.

This ſpot alſo appeared, as was expected, larger when at, or near the centre of the planet, and by degrees grew ſmaller as it approached the edge, and that in ſo conſiderable degree that it was always loſt to the ſight entirely, before it arrived at the edge of the planet's diſk. Its motion alſo was found to appear quicker when near the centre, than when toward the circumference. Theſe appearances of a ſpot on an heavenly body, will be explained at large in the ſucceeding account of thoſe on the ſun, and thither we ſhall refer for the reaſon of the aſſertion; but it is very ſafe to aſſert, that this encreaſed magnitude and ſwiftneſs of the ſpot, as it approached the centre of the diſk, ſufficiently prove, that it was not at a diſtance from the body of the planet, but adherent to its ſurface; and that it turned round on its axis by a movement, which conſidered from the centre of Jupiter, was made from weſt to eaſt. This muſt be, as it appeared, from eaſt to weſt to our eye.

Spots of this kind are not to be always expected on the body of Jupiter; the ſame ſpot is not to be ſeen at all times. This which was the ſubject of Caſſini's obſervations was viſible for about two years after the time of his firſt ſeeing it, and after that it diſappeared for five or ſix years; at the diſtance of which time it was again ſeen in the ſame form and ſituation as at firſt. On comparing the obſer-

vations, after an interval of ſix years, the revolution of the ſpot was found, at the end of that time, to be performed in nine hours, fifty-five minutes, and fifty-one ſeconds; and two years after in nine hours, fifty-five minutes, fifty-three ſeconds and a half; ſo that it was after this time ſlower by two ſeconds and an half in a revolution.

All the aſtronomers bent their obſervations on Jupiter from this time for ſeveral years. The moveable ſpot was firſt ſeen in 1665, it diſappeared after two years, and was not ſeen again till 1672, and in 1675 and 1676, it was inviſible again: but, as thoſe who look after one thing often find another, although the ſpot was not ſeen in theſe two years, ſeveral very remarkable changes happened in the planet, which, in all probability, would not have been taken notice of, but for the great attention that was paid to it on that occaſion. A particularly clear and bright ſpace was obſerved upon the body of the planet, between two of the obſcure belts, divided and broke of itſelf into ſeveral parts, as it were into ſo many iſlands, the obſcurer traces, made between them by the diviſion, repreſenting the currents of rivers, or little arms of ſeas. The two obſcure belts had been only at a ſmall diſtance from one another from the beginning; and this clear ſpot, now divided into ſeveral portions, had been the broadeſt part of the diviſion between them. As the obſervations were continued on them, the tracts of a more duſky hue between theſe ſeveral new-formed iſlands, grew larger, and the belts, between which the whole cluſter were placed, drew nearer and nearer together, by both theſe means the ſpots grew leſs and leſs continually, the general cluſter diminiſhing as much as the ſingle portions, till, by degrees, like iſlands undermined, and worn away by the ſea, they were quite obliterated and effaced. They ſeemed eaten away by degrees, and at length ſwallowed entirely by the waters, and the two obſcure belts, which had been ſeparated by them met, and formed together only one very broad band. Jupiter, at this time, became loſt in the ſun's rays, but the year after, when he was out again, things were obſerved to have taken their original form and ſituation. The broad band, formed under the eye of the obſerver out of two narrower, was again divided into two, the ſpace was ſeen between them, and the lucid ſpot re-appeared entire, and in the exact form it had been ſeen in before the diviſion into the ſeveral iſlands. This may give ſome idea of the nature of that change, which has been ſpoken of in the belts of Jupiter, and explain the wonder of ſometimes more, and ſometimes fewer of them being ſeen. We ſee the abſolute number may vary, and that out of one may be formed two or more, or out of more only one.

This lucid ſpot was very proper for obſerving in its motions. The revolution of it was exactly remarked, and was now found to be performed in nine hours, fifty-five minutes, fifty-two ſeconds, and ſix thirds. This was at the end of about twelve years from the time of the obſervation of the firſt ſeen moveable ſpots, revolving round the body of the planet, which was performed in nine hours, fifty-ſix minutes. This, compared with a number of other obſervations on the revolutions of this, and other ſpots, ſince that time, ſhews, that there is ſome little difference in the period. The revolution of this ſpot is the revolution of the body of the planet on its own axis; for being fixed to the ſurface of the planet, it can revolve or change place no other way; and the time of its coming to the ſame place gives the time of the planet's revolution. We ſee this to be about nine hours and fifty-ſix minutes, or a little leſs; but on

nice

nice obſervations we ſee the time not to be always exactly the ſame. There are found differences of a few ſeconds in the period, when the obſervations are made with the moſt conſummate accuracy; and theſe are not between periods near to one another, but thoſe obſerved at conſiderable diſtances. The difference of two ſeconds and a half was eaſily diſcovered, and that, at various intervals, has been ſeen ſince. Upon comparing the obſervations, with the place of the planet, with reſpect to the ſun, we ſee that this is not accident, or at irregular times, but according to the diſtance of the planet from the ſun. This is a truth of importance, and is clearly made out by obſervation. It appears, that when Jupiter is in the part of his orbit neareſt to the ſun, his revolution round his own axis is ſomewhat quicker, than when he is at his greateſt diſtance from it. The ſpot moves round in leſs time by ſome ſeconds in that ſituation than in this. The ſame thing has been obſerved of the earth as to her revolution round her axis, in proportion to the diſtance, or nearneſs of the part of his orbit, in which ſhe then is with regard to the ſun; and we have double reaſon to be convinced of the things obſerved in one of the planets, when we ſee them in another.

This bright ſpot, whoſe original appearance and variations had been taken ſo much notice of, was carefully watched; but after the reuniting of the ſeveral parts it diſappeard, and continued inviſible for no leſs a ſpace of time than eight years: after this it appeared again, exactly in the ſame place, and of the ſame form and dimenſions. It now continued viſible for two years: and at the end of this time was quite loſt again; three years after it appeared again as obvious and as lucid as at firſt. It was nearly of the ſame figure as at firſt, and adherred to the ſouthern belt at one part. Much about this time, which was in the year 1690, another ſpot was diſcovered between theſe two belts, which had occaſionally united. This was quite unlike the former, not brighter than the reſt of the ſurface of the planet, but darker, and more like the belts. If the other had been taken for an iſland, this might be called a lake, ſuppoſing the belts to be ſeas, and the intermediate ſpace dry land. This had much the appearance of a lake indeed; but although it has been the cuſtom, both with regard to the diſks of the planets, and to that of the moon, to call the brighter parts ſeas, and the more duſky land; yet it by no means agrees to what one ought to conceive of thoſe bodies; the ſmoother ſurface of water ought to reflect the light more ſtrongly, and conſequently to be brighter, not darker, than that of the land. And indeed the diſtinction ſeems in this the more faulty, that there is great reaſon to ſuppoſe there is no water at all in the moon, as there are no exhalations, clouds, or atmoſphere about her. Thus much may be neceſſary to excuſe the uſe of ordinary terms, inſtead of more appropriated; for to be underſtood, it is neceſſary to ſpeak according to the received cuſtom.

The ſpot, now firſt ſeen on the diſk of Jupiter, adhered to the more northern of the two belts, and was of a dark colour, and roundiſh figure. The ſize was about the ſame with that of the ſhadow of the third ſatellite, when it falls on the body of the planet: it covered about a twentieth part of the ſurface of the planet. A little ſpeck; but if we compute according to the diſtance, it will appear ſomething; it muſt have been, be it what it would, as large as all the continent of Africa, on our globe.

This ſpot was not leſs ſubject to change of form than the firſt. From the round figure firſt ſeen, it was in a few days perceived when about the centre of the planet's diſk of the

the figure of a crescent, the points of which were turned towards the northern belt, it changed figure several times after this, and that very remarkably, till at length it became divided into three spots, the one at a little distance from the other. The first of these, to the westward, was the least of the three, and adhered the most perfectly to the belt; the second was the largest of the three, and the most distant from it; and the third, or eastern spot, of a middle size between the other two, and although it did not touch, was but at a small distance from the belt. These were formed of the two horns, and the centre of the crescent; they changed figures several times after, indeed more or less from day to day, and at a little distance of time formed a figure like what our heralds call a chevron, the point of which was turned toward the belt, and the space adhering toward the centre, became so bright that it had the appearance of a mountain, of which the rest seemed but the shadow. Sometime after a long spot appeared in the centre, a roundish one before, and an irregularly figured one just after it. This was distant from the middle one about a ninth part of Jupiter's diameter. The revolution of the middle spot was performed in the space of nine hours, and fifty-one minutes. These spots changed less after a time, than they had done at first; but they continued visible in the same parallel of the planet about two months; and then totally disappeared.

The disappearing and re-appearing of these spots on the body of Jupiter, and their change of figure during the time of their appearance, is not the most wonderful among the changes we see in the disk of that planet on a continued observation. His belts, which have by many been imagined seas, and which take up so considerable a part of his surface, one would suppose should naturally be more permanent; but this is not the case. We have already observed, that they are liable to changes; but it is scarce to be conceived how quick those changes sometimes happen. The elder Cassini in 1690, while he was busy in remarking these spots, saw one evening, very distinctly, five bands, or belts, upon the planet, two northward, and three southward, they were all very conspicuous and distinct; but while his eye was upon them, they suffered the most surprising change. In an hour from their fairest and fullest appearance, there remained only three out of the five, and one of these scarce perceptible, two had absolutely disappeared, and a third very nearly. This was not a change like that in regard to the two belts, between which the famous spots were observed, and which, joining together, made only one broad one in the place of the two narrower. The two that remained of these five, after so short an observation, were those nearest to the centre of the planet, and they were not at all broader than at first. The vestige that remained of one more was distant to the north, and the places of the two others clear.

After a few hours more there appeared between the two remaining belts toward the east, two little black spots not seen before. These were very distinctly visible, because the space between the two belts was very bright and clear; they were of a roundish figure, and adhered one to the edge of the upper, and the other to the edge of the under belt, almost opposite to one another. These made their revolutions in the same manner as the others, in nine hours, fifty-two minutes; and after a short duration on the body of the planet, without any visible change of figures, they disappeared, as the others had done before them.

Soon after the vanishing of these there appeared a single large spot between the two princi-

principal belts, in a place were none had been ſeen before: after this three ſpots at a diſtance, in a yet different place, of the ſame interſtice between theſe two belts, and afterwards others.

It is ſingular, with regard to theſe ſpots, that they almoſt always appear in the bright ſpace between the two principal belts for the time being. They change figure frequently, and often from round they become oblong. When this change is made it is always according to the direction of the belts; they are all of them adherent to the ſurface of the planet, not bodies at a diſtance from it; and although they appear ſuch ſpecks to us, are of an extent amazingly great on the body of the planet. They all make their revolutions in periods within four or five minutes equal to one another, between fifty and fifty-ſeven minutes beyond nine hours is the extent of the time; and it appears on the niceſt obſervation, that thoſe, which are neareſt the centre of the planet, make their revolutions in the ſhorteſt time, and thoſe which are moſt remote from the centre in the longeſt. Of all the ſpots, thoſe which have the ſwifteſt motion, are thoſe which happen to be neareſt to the equinoctial of the planet, which is parallel with the belts. From this, if we fall into the opinion of the belts of Jupiter being ſeas, we may compare the motion of theſe ſpots in ſome reſpect to the currents on our globe, which are ſwifter, ſtronger, and greater near the earth's equator, than in any other part.

There is not any object that will afford the contemplative aſtronomer more opportunities of employing his faculties than Jupiter. Theſe changes in his ſurface, for they muſt be of vaſt conſequence, are ſubjects of the moſt deep enquiry as to their cauſe. They are to be ſeen at all times, more or leſs, with the aſſiſtance of teleſcopes of ſufficient power; but the beſt time is to ſieze upon that part of his revolution in which he is neareſt to the earth, for Jupiter at ſometimes, and Jupiter at others, is an object ſtrangely different with reſpect to diſtance from us. Nor is leſs regard to be paid to his belts than to theſe ſpots, the changes in them, though often as ſudden, are not ſo frequent; for when a new ſpot appears it almoſt always varies quickly, and continues for ſometime varying; but theſe in the belts are more conſiderable, and indeed to the reaſon, as well as to the eye, they are more aſtoniſhing. Two or three belts are uſually ſeen, and of theſe one, the northern one, ſeems the moſt permanent. From the very time when the belts of Jupiter were firſt ſeen, which was in 1630, this has always continued viſible, whatſoever changes have happened to the reſt; and it is uſually the moſt conſiderable of thoſe which appear at whatever time. It is but at a little diſtance from the centre of the planet to the north, and is generally uſed to compare the reſt. This is commonly of a darker colour than the others, and broader than any of them naturally are; but we often ſee two of the others join, and then they exceed it in breadth; and this alſo may happen unſeen to us. As it is the moſt fixed in its nature, it is the leaſt of all ſubject to change in its appearance. In the others there frequently are ſeen lucid ſpots like iſlands, in this rarely. The ſpots which are in the interſtices often adhere to its edge, and ſometimes ſeem produced from it. This belt always reaches completely acroſs the body of the planet, and is diſtinct to the extremities. The others appear and diſappear at times, and this very ſuddenly. They are narrower, and uſually fainter in colour than this; they are often more or leſs ſtrong, and diſtinct at one hour than at another, and very frequently they do not reach quite acroſs the planet; but are only ſeen over the central part, and terminate before

before they are continued to either ſide. I have often ſeen one of theſe belts begin in a clear ſpace of the planet's diſk, and extend itſelf by degrees quite acroſs; a belt, and a very conſpicuous one, has thus been extended parallel to the great one in an hour and a half from the firſt appearance of it on the eaſtern edge of the diſk, and has continued very clear and diſtinct a long time. The compaſs of one evening will ſometimes ſhew the face of this planet, with one, two, three, and four belts. New belts are often formed in an hour or two; and we frequently ſee a belt wanting on the eaſtern edge, and coming out by a little and little of the weſtern. This makes it evident that there are, on the ſurface of Jupiter, interrupted belts which ſhew themſelves, and again withdraw their appearance on his apparent diſk according to his revolution round his axis. It is common, when we have been viewing the planet for ſome time, to looſe a belt, and after a while to have it re-appear; when we have remarked the places of two conſiderably diſtant, another ſhall grow between them, and often beyond all thoſe which we have ſeen there ſhall appear others very faint at firſt, and gathering ſtrength afterwards, and appearing more dark and obſcure: all theſe run, for the moſt part, parallel with the great or original belt, and with one another, but ſome few years ſince I had an opportunity of ſhewing an oblique one to moſt of the aſtronomers of this time. It was not the firſt, or the moſt oblique, that had been ſeen, but the thing is ſo rare, that many had diſbelieved it.

This is not the only ſingularity we have of late ſeen in this planet. From four very apparent belts we have ſeen one vaſt obſcure blotch upon its ſurface. I have already mentioned two of the belts joining together; in this caſe four did ſo, and the planet never made ſo duſky an appearance. There were many ſmall, and ſome conſiderably large ſpots appearing like iſlands in this vaſt ocean, and theſe changed figure faſter than any before ſeen. It was a great while before the planet recovered its priſtine appearance and general ſplendor: when it did ſo the ſingle original band or belt only was ſeen, and Jupiter never looked ſo bright or fine. The French aſtronomers obſerved an appearance of this kind much earlier, but when it was over four diſtinct bands were ſeen, and not a ſingle one.

Although the great belt, or that immediately to the north of the centre, be the leaſt ſubject to ſpots and changes, they ſometimes happen there, and are no where ſeen ſo diſtinctly, or beautifully. We have had none of them lately, ſo that we muſt refer to the accounts of them. About ſixty-two years ago there appeared a very large and very bright ſpot in it almoſt equal to its whole breadth, and in a manner interrupting the courſe. Soon after this another of the ſame dimenſions, and ſoon after that two others leſs bright, and oppoſite to one another. There were at this time two other belts on the planet, both very diſtinct and plain, but much narrower than the other. Soon after the appearance of theſe ſeveral ſpots, the belt itſelf began to diminiſh in breadth, and grew viſibly narrower from time to time; the others alſo grew larger at the ſame period, till at length they were all three equal. Thoſe who were convinced of the opinion, that theſe belts were ſeas, thought it eaſy to account for this from a deficiency of water in the great one, which had firſt ſunk in depth, ſo as to ſhew in the ſhallower places large parts of its bottom, and at length from the ſame cauſe deſerted its ſhores. It were well if they could as eaſily have accounted for the loſs of its waters, as for the effects of ſuch a loſs. They went ſo far as to ſuppoſe it emptied itſelf into the two others, and even perſuaded themſelves

that

that they ſaw traces of communication between them. It was ſometime after this uncommon change that things recovered their former appearance and ſituation. Eight different belts, parallel to one another, were at ſome diſtance of time perceived on the ſurface of the planet; but they were all faint and dead, except the great northern one, which ſtill diſtinguiſhed itſelf among them; before this happened the three equal belts had frequent new ſpots, and ſometimes abſolute interruptions in them. The water which had filled the principal belt was ſuppoſed not ſufficient for them all; but theſe philoſophers never attempted to account for the eight that followed. At about a year after this, the famous ſpot which had ſometime before appeared, divided itſelf and diſappeared, was ſeen again in its old place; it was near the ſouthern belt, and although not contiguous, yet had probably ſome trace of communication with it, though too minute to be diſcovered, for it depended abſolutely on that belt. The belt ſoon after was in great part effaced, and the ſpot was loſt with it. Two years after it appeared again, and the obliterated belt with it. This is of all the ſpots that have been ſeen on the body of Jupiter, the moſt conſiderable and the moſt remarkable; it evidently keeps its place, altho' it ſo often, and for ſo long a time diſappears: at this return it continued two years viſible; and was after that loſt for fourteen years. In the year 1708 it appeared again very viſibly, and it has occaſionally been ſeen ſince.

The Greeks, in order to give themſelves the honour of having invented the ſcience of aſtronomy, not only adapted the ſeveral fables with which their early hiſtory abounded, to one or other of theſe conſtellations, or arrangements of ſtars, which they had received from the Egyptians, but they even would make ſome part or other of their ſtory agree with the planets themſelves, There was artifice in this, and the Greeks, who were not leſs cunning than ambitious, are the moſt natural people in the world to have had recourſe to it. They found that at the time when Thales brought the rudiments of the ſcience out of Egypt, all the reſt of the world were ignorant of it; and as they ſaw they ſhould have the glory of teaching it to the reſt of mankind, it is not ſtrange, that they wiſhed to hide its being of the origin of ſome other country. That place was moſt likely to be ſuppoſed in after ages the birth-place of a ſcience, with whoſe ſtory the ſeveral parts of the ſcience coincided. They therefore gave ſome part of their fable, as the occaſion of every conſtellation, and the origin of every planet; for theſe ſingle luminaries, like the ſeveral congeries of the others, they pretended to be from men, or other creatures raiſed to that elevated ſtation. Thus the Bear was Caliſtho, whom Jupiter transformed into that creature on the earth, and then took up into the ſkies; the Dragon was that which guarded the Heſperian gardens, and ſo of the reſt. In this plan they tell us, that the planet Jupiter was once a mortal being. They ſay, that when Prometheus made men, there was one whom he finiſhed more highly than the reſt, and called him Phaethon. This, they ſay, was much earlier than that Phaeton who adventured to guide the chariot of his father Phœbus. They ſay, that Jupiter being told of this charming youth, thought him too good for the earth, and ſending Mercury to invite him into the heavens, placed him for ever there in the bright planet, called by his own name. They tell us, that the other Phaeton was afterwards tranſlated in the ſame manner into the ſkies, and made the planet Saturn, which was therefore, they ſay, called Stella Solis.

Jupiter is alſo a name by which ſome of the old writers call the conſtellation Aries, they call it Jupiter Ammon.

JUSTICIA. A name by which ſome of the old aſtronomers have called the conſtellation Virgo. They ſuppoſed it, according to the Greek fable, to have owed its origin to the removal of that lady from the earth. They make her the daughter of Jupiter and Themis, or of Aſtræus and Amora, and fix her period to have been that of the golden age. While men were innocent and virtuous, they ſay ſhe ſtaid among them; but when their crimes grew intolerable, ſhe fled up to heaven, and now ſhews herſelf to them under the form of this conſtellation. *See* VIRGO.

IXION. One of the northern conſtellations, according to the writings of the old Greeks. It is a name they gave to that conſtellation, which we uſually call Hercules, and which the earlieſt writers among them called Engonaſin. The Greeks received their aſtronomy from the Egyptians, and among the reſt of it the figures of the conſtellations. They did not underſtand what a man on his knees, as they received it from the Egyptians, meant. Probably that people, fond of hieroglyphic, intended to convey this moral by it, that devotion carries men to heaven; the Greeks, who aimed to bury the remembrance of their obligations to this people, and to perpetuate aſtronomy as of their own invention, adapted one or other of their fables to the Egyptian figures. They called this Ixion, and ſuppoſed him kneeling, and ſupplicating pardon for his intent on Juno, At other times they made it Prometheus, Orpheus, and Theſeus, but at laſt Hercules, and ſuppoſed him fighting with the Heſperian dragon. *See* HERCULES.

IXIONIS ROTA. A name given by ſome to the conſtellation Corona Auſtralis. It ſeems to have been originally repreſented in the figure of a wheel, and not a crown.

IZAR. A name by which ſome have called the bright ſtar in the girdle of Andromeda. It is an Arabian name for that ſtar. They alſo call it Mizar.

K.

KAMAN. A name by which we find the ſign Sagittary mentioned in ſome of the old writers on aſtronomy. It is the Perſian name of that conſtellation.

KASCHI DERUISHAN. A name by which ſome, who are fond of uncommon words, have called the conſtellation Corona Borealis. It is one of the Arabic names of that conſtellation; and ſignifies in the exact ſenſe of the words Stella Pauperum.

KASE SHEKESTE. A name by which ſome, who are fond of uncommon words, have called the Northern Crown; it is one of the Arabic names for that conſtellation, and ſignifies Stella Fracta. It was originally drawn in form of an incomplete circle.

KATHA. A name by which ſome, who are fond of uncommon terms, have called the conſtellation Cygnus. It is one of the Arabic names of the conſtellation; but it does not ſignify a ſwan, but a ſmall water fowl, of the bigneſs of our moor-hen.

KATHARINE, *or* ST. CATHARINE. A name of one of the northern conſtellations according to Schiller. This author will make every conſtellation in the heavens refer to ſome Chriſtian hiſtory, and he has accordingly taken away the figure of the Eagle, and put that of this female martyr in its place. Schickard retains the Eagle, and calls it the ſtandard of the Roman empire.

KAUS, *or* AL KAUS. A name by which ſome, who are fond of hard words, have called the conſtellation Sagittary. It is the Arabic name of that ſign. Others call it Keſheth, after the Hebrew.

KEIKAUS. A name by which ſome call Cepheus. It is one of the Arabic names of that conſtellation, but it is nothing more than a miſpelling of Keiphus.

KEIPHUS. A name by which ſome, who are fond of uncommon words, call the conſtellation Cepheus. It is its Arabic name, and is only their way of writing Cepheus.

KEKEUS. A name by which ſome affect to call Cepheus. It is one of the common Arabic names of the conſtellation, but is only a miſpelling of Keiphus, Cepheus.

KELB, *or* AL KELB. A name by which ſome have called the bright ſtar, which is between the feet of the conſtellation Cepheus. It is an Arabic name, and ſignifies a dog. They call the bright ſtar in the foot Al Rai, the ſhepherd, and the cluſter in the hands Al Aglinam, ſheep.

KELBASGHER. A name by which ſome, who are fond of uncommon words, have called the conſtellation the Little Dog. It is its Arabic name, and ſignifies a little dog.

KELB HA GILBBOR. A name which ſome, who are fond of hard terms, have uſed for Orion. There is authority for this, for it is the Hebrew name, at leaſt one of the Hebrew names of the conſtellation. The ſignification of the term is a ſtrong and fierce dog; but in their figurative manner it may very well ſtand for a warrior.

KESHETH. A name by which ſome of the fanciful writers in aſtronomy have called the conſtellation Sagittary; it is the Hebrew name of that ſign.

KESHTO. A name by which ſome have called Sagittary; it is the Syriac name of that ſign.

KHIUN. A name given by ſome of the old aſtronomical writers to the planet Saturn; it ſeems to be one of his earlieſt names, and is that by which he was called among the Jews.

KHOKHAB ZEDEC. A name by which ſome of the aſtronomical writers have called the planet Jupiter. The ſignification of the term is *the ſtar of juſtice*. The aſtronomy of certain periods was much diſgraced by being blended with their judicial aſtrology, and this ſeems to be a part of that folly; the naming a planet from ſome imaginary influence.

KIDS. A name given by ſome to two ſtars in the arm of Auriga. Cleoſtratus firſt dignified them with a peculiar name; and gave origin to the old opinion of their cauſing tempeſts.

KIKANS. A name by which ſome call Cepheus; it is a miſ-ſpelling of the Arabick Keiphus.

KIN. A name by which the Chineſe aſtronomers expreſs the planet Venus. The word ſignifies gold, but for what particular reaſon they have applied it to this planet is not eaſy to ſay. They alſo call Venus Taipe, the ſenſe of which is ſomething very white; the reaſon of this is obvious.

KING OF BABYLON. According to Hartſdorf, one of the northern conſtellations, Cepheus.

KIR SCHETALI. A name by which ſome, who are fond of obſcure and uncommon words, have called the conſtellation Corona Borealis, the Northern Crown; it is the Hebrew name of that conſtellation, and the exact meaning of the word is the Left Crown. Corona Siniſtra.

KITA AL PHORAS. A name by which ſome have called the conſtellation Equuleus, or Equiſectio; it is one of its Arabic names, and ſignifies a part of an horſe, or a ſegment of an horſe, as the Greeks alſo called it.

KLARIA. A name by which the aſtrologers, and ſome of the aſtronomers, who love hard words, call the conſtellation Cancer; it is the Coptic name of the conſtellation, and, in that language, ſignifies no more than a beaſt or animal in general.

KNOT. A name by which aſtronomers expreſs a bright ſtar between the tails of the two fiſhes in the conſtellation Piſces; it is between the northern and ſouthern lines, dividing thoſe ſtars, which are expreſſed under that denomination, into two ſeries, the northern and ſouthern line.

*KOIRUGHT. A name under which we find the constellation Scorpio mentioned in some of the old astrological writings; it is the Turkish name of that constellation.

KOS, *or* Kus. A name by which some have called the constellation Crater; they are the Hebrew names. Others call it Alkas, the Arabick, or Badiya, the Persian, name.

KUBBA. A name by which some, who love uncommon words, have called the constellation Corona Australis, or the Southern Crown; it is one of its Arabick names, and does not signify, in that language, a crown, but a tortoise. There seems to have been a great diversity in the figures under which this constellation was originally represented; for we find some calling it a garland, some a crown, some a wheel, and some a tortoise. The name Rota Ixionis, or Ixion's Wheel, is very common in the Latin authors.

KUGHA. A name by which some, who are fond of hard words, have called the constellation Aquarius; it is the Turkish name of that sign.

KUS. A name by which some have called the constellation Gemini; it is its Turkish name. The word, in the Turkish language, signifies a nut, and so does Giauza, one of the Arabic names of the same sign; perhaps a pair of twin nuts was one of its figures

KUZI. A name by which some have expressed Aries; it is the Turkish name of the constellation, and it signifies, as do also most of the names in other languages, a lamb of the full growth.

L.

LACERTA, *the Lizard*. One of the new conſtellations of the northern hemiſphere; it is one of thoſe which Hevelius added to the forty-eight old ones, and which he deſigned out of the unformed ſtars of the earlier catalogues, or thoſe which had not been taken in within the out-lines of any of the other figures.

The Lizard is but a ſmall one, but it contains a very fair proportion of ſtars for its extent, and theſe are ſo diſtant from all the other figures, and ſome of them at ſuch a nearly equal diſtance from all of them, that they could by no means be ſo well ſpoken of any other way.

It has been obſerved of the new conſtellations, that they are in general better drawn than the old ones, that is, that the figures, under which they are repreſented, have more reſemblance to the creatures, whoſe names they carry, than the others, but this is not univerſal. If the Bears of the old aſteriſms have long tails, and their Serpents have hair upon their heads, the Lizard of Hevelius is as unlike a lizard as any, the very worſt of thoſe can be to the creature it repreſents; it has conſiderably more the look of a greyhound, or ſome other quadruped of that kind, than of any thing that approaches to the lizard claſs. It is repreſented under the form of a long-bodied animal, with a long head, thick legs, ears, and a tail not continued from the body, but affixed to it as in the quadrupeds. It is repreſented in a poſture of running, and with the mouth open.

The conſtellations, between and among which the Lizard is placed, are the Horſe, Caſſiopeia, Cepheus, the Swan, and the Fox. There is a ſpace left between theſe, and the Lizard ſtands nearly in the middle of it, but does not fill it. Pegaſus is placed behind it; the tail of the Lizard comes down juſt to the fore foot of that conſtellation. Caſſiopeia is alſo behind it, and above it an arm of her chair is over its head, but at a diſtance, and one of the hands of Andromeda comes near the back. The head of the Lizard is directed toward the head of Cepheus, and its fore feet come near the tail of the Swan. The tail of the Fox is oppoſite to the hinder feet of the Lizard, but there is a ſpace between, and even the two feet of the Pegaſus are in ſome degree between them. The conſtellation is ſurrounded with the yet unformed ſtars of ſeveral of theſe. The ſtars accounted to it by Hevelius, who deſigned it, are only ten, but Flamſtead has counted ſixteen. Not one of theſe is of the greateſt magnitudes, but there are ſome ſufficiently conſpicuous; there is one in the noſe a little forwarder than the place of the eye, another in the neck, and one in the ſhoulder. There is alſo one at the loins, and one on the belly nearly oppoſite to it, and there are four on the tail, three of theſe are in the bend toward the middle, and one near the extremity. Theſe are the ſtars which are moſt conſpicuous in the Lizard. The reſt are ſmall, but theſe are

are a ſufficient number to mark the conſtellation.

LAMB, *or* PASCHAL LAMB. A name, according to Schiller, and the ſet of enthuſiaſts who follow him, of one of the conſtellations. It is the Canicula, or Little Dog, that they call by this name. They have very little altered the figure, the ſtars ſtand in the ſame parts of the animal.

LAMBADIA. A name by which ſome, who are fond of uncommon words, have called the conſtellation Libra; it is the Coptic name, and ſignifies Statio Propitiationis.

LAMPADIAS. A name given by ſome to the great ſtar in the Bull's eye, called Aldebaran.

LAMPIS. A name given by many of the old Greek writers to the planet Saturn. This ſeems to have been meant as a ſynonyan for the older name Phænos or Phænon, by which it is called by Plato, and ſome of the oldeſt among the Greeks, but it is not ſo proper. Saturn is far from being conſpicuouſly bright among the planets, but yet Saturn had a title to the name of Phænos, conſpicuous in preference to them all, ſince he is leaſt of all of them obſcured by the ſun's beams. It was with this view that the antients diſtinguiſhed Saturn by a name that ſignified conſpicuous, and with this view, that they alſo called him Nyctiurus, the guardian of the night, becauſe he is ſeen in a greater part of the revolution than any other planet, and conſequently is the planet moſt conſtant to the night, or moſt ſeen in the heavens, ſpeaking in general terms and of general time.

LANCE AND NAILS. A name of one of the northern conſtellations according to Schiller. He makes every thing a Chriſtian ſtory, and he alters the conſtellation Sagitta into this form of a ſpear and ſome nails, and calls them the inſtruments that wounded our Saviour.

LAR. A name by which ſome, who love uncommon words, call the conſtellation Ara, the Altar. It is an odd name, but we meet with it in ſome of the old Latin writers.

LATITUDE. In mentioning aſtronomical obſervations made in different places, it is very neceſſary to know where thoſe places are, that is, in what part of the earth reſpectively to certain eſtabliſhed diviſions. To this purpoſe the earth is ſuppoſed divided by two circles, which cut one another at right angles, and each encompaſſing the whole earth, they, together, divide it into four parts, each making two hemiſpheres, and the other dividing each of thoſe two again into two parts.

Theſe circles are of different natures, the one fixed and permanent, the other variable at pleaſure, but ſtill being fixed for the preſent obſervation, it anſwers all the purpoſes of this diviſion. The one of theſe circles is the equator, the other the meridian. The equator is a fixed circle encompaſſing the earth at an equal diſtance from either pole; the other is a circle cutting that, and extended through both the poles, but as circles of this denomination may be made to paſs through all parts of the earth's ſurface, it is neceſſary to eſtabliſh ſome one as the principal from which to meaſure all the others. This being done, it becomes as much a fixed circle of the earth as the other, and it is eaſy to meaſure the diſtance of any place from the one and the other of theſe; that is, it is eaſy to find its place upon the earth's ſurface.

Aſtronomers

Aſtronomers and geographers, finding the neceſſity of a fixed circle paſſing through the poles, as well as of that paſſing round the earth between them, have eſtabliſhed, at all times, ſome one of theſe many circles that might be ſuppoſed to paſs ſo through them as this fixed one. This place, from which to meaſure, and this fixed circle, is what they have called the great meridian, the fixed meridian, or the firſt meridian. Meaſuring from this eaſt and weſt, as from the other north and ſouth, they find the true place of any point upon the earth's ſurface. This fixed circle has not been the ſame at all times or with all people. The Greeks made it run through the iſland of Hera, one of the fortunate iſles, the Arabs through the extreme coaſt of the weſtern ocean, ſome of the late aſtronomers have made it that which paſſes through Corvo, one of the Azores iſlands, and the lateſt of all through the place where they happen to live. Thus if the aſtronomer reſides in Holland, the firſt meridian is that of Amſterdam, and from thence he meaſures all places eaſt and weſt; if he lives in Paris, the meridian which paſſes thro' the obſervatory, that obſervatory being the place where he makes his obſervations, is the firſt meridian; if in London, the firſt meridian is that which paſſes through that city.

It is enough to name one place through which this circle paſſes, for as it goes through the two poles of the earth, it is only neceſſary to know any one ſpot in order to know the courſe of it over all the earth. The modern geographers are not to wonder that the pike of Teneriffe was not named among the places from which the firſt meridian was at ſome time dated. It was long a cuſtom to make the circle, paſſing through this iſland, the great meridian; and Bleau, and ſome other geographers, count from it in their maps, but this is the ſame with the old Greek meridian, the iſland which they called Hera, and the Latins Junonia, being this Teneriffe. As to the reſt, the Greeks choſe it, becauſe, being the moſt weſtern part of the world known, it beſt anſwered the purpoſe of their meaſure, who always counted the degrees only eaſtward.

This meridian is what concerns what is called longitude, as the equator what is called latitude; but in order to underſtand the one, the other muſt be explained with it. Whichſoever of theſe places be fixed for that through which the firſt meridian is to paſs, there is one great circle of the earth fixed from pole to pole, and the equator being altogether a fixed circle, there is another at equal diſtance from the poles; and the earth being globular, or ſpherical, it is evident that there can require no more for the meaſuring and aſcertaining the place of any point on its ſurface than a reference to theſe two circles. Through whatſoever place the firſt meridian paſſes, that being a known and fixed point, the meaſure is equally eaſy.

Every great circle, whether of the earth or heavens, (for all theſe circles of the earth have their correſpondent circles in the heavens) is divided into three hundred and ſixty equal parts, called degrees, and each of theſe degrees is again divided into ſixty minutes, and each minute into ſixty ſeconds. The diviſion is carried farther proceeding by ſixties, but the ſub-diviſions below theſe are ſeldom uſed. Now it is eaſy to mention the diſtance of any two places by theſe degrees, becauſe it is eaſy to meaſure the quantity of the arc of the circle that is intercepted between them; and the bigneſs of the earth being known, it follows, that, in the whole, the matter is ſufficiently diſtinct and plain.

The quantity of degrees and minutes, eaſt and weſt, by which one place is diſtant from another, is the diſtance of thoſe two places in longitude,

longitude, and is to be determined by the meridians, and measured on the equator; and the quantity of degrees or minutes, north and south, by which any two places are distant from one another, is their distance in latitude, and is to be determined by parallels to the equator, and measured on the meridian. The absolute longitude of any place is its distance from the first or fixed meridian, east or west; and the absolute latitude of any place is its distance in degrees and minutes from the equator, north or south. Thus all those places, which are situated on the equator, or, as is the usual form of expression, which lie under the equator, have no latitude at all; with respect to all other places, whether near the line, or remote from it on either side, they are said to be in so many degrees of latitude, as they are degrees distant from the line; and this is called north-latitude, when they are between the equator and the north pole, and when they are between the equator and the south pole, it is called the south-latitude.

LATITUDE, *Circles of.* Those great circles of the sphere, which pass through the poles of the ecliptic, and thro' a star. On these circles astronomers measure the distance of that star from the pole of the ecliptic, the complement of which distance is the latitude of the star. The geographers express, by the name of latitude, the distance in degrees of any place on the surface of the earth from the equinoctial, which they measure on the meridian line of that place. This distance is equal to the height of the pole in that place.

LEBANAH. A name by which some of the old astronomical writers have called the moon. It is an oriental word, and imports whiteness, and was given her from her colour.

LEFT, *Part of the Heavens.* Different people mean different and contradictory things by the same term. It stands for all the parts of the compass according to the idea of those who use it. With the astronomer it is the eastern part of heaven; with the geographer the west; with the old augurs the north, and with the poet the south. The astronomer always looks south, the geographer north, the augur east, and the poet west; and this causes the difference.

LEGS, *of an Angle.* Express the two lines whether they be strait or crooked, which, touching in a point, form the angle by their opening.

* LEO, *the Lion.* One of the constellations of the northern hemisphere, and a very considerable one. All the writers of astronomy, of whatever age or country, mention it, and it is one of the old forty-eight constellations, and one of the twelve signs of the zodiac.

It is a constellation of very considerable extent, and contains a large quantity of stars, some of them of considerable magnitude, and the greater part of them very luckily disposed, or placed on conspicuous parts of the figure. The creatures of the heavens are, many of them, very unlike those of the earth; the Bears of the stars have long tails, and the Dolphin is as crooked as the horn of the Ram; but the signs of the zodiac are, in general, better figured than the other constellations, and this is one of the best and most regular even of those. It is a figure of the savage in a posture of running, but not violently, his mane is large, and his tail twisted or curled; his buttocks are too large, but that is easily pardonable, many an earthly painter makes the same blunder. The Lion is, of all animals, the least bulky for his size behind; but it is not every designer that is naturalist enough to be in that secret.

The constellations, between and among which the Lion is placed, are the Little Lion, Cancer, Hydra, the Sextant, the Cup, Virgo, and Berenice's Hair. The Little Lion is placed just over the great one, and a little forwarder, his head reaches just beyond that of the other; Cancer is immediately before him, they stand face to face, and at a very little distance from one another. The Sextant is close under his fore paws, and the head and part of the body of the Hydra is just before that, or between it and Cancer. The Cup is below the hinder feet of the Lion, and at a little distance, and Virgo is just behind him. The Coma Berenices is a new constellation formed out of those just over the Lion's tail, and the stars which it contains are, by some, accounted into the number of those of the Lion.

The constellation Leo contained, according to the old astronomers, thirty-five stars, but then they counted into the number those of the Coma Berenices; the later astronomers generally speak of the Lion separately from that constellation. The Lion then contains, according to Tycho Brahe, thirty stars; Hevelius counted in it forty-nine, and Flamstead has set down no less than ninety-five. Among these there are two of the first magnitude, and as many of the second, six or seven of the third, and many of the fourth, and fifth in general the lesser stars are in smaller numbers in proportion in the Lion than in almost any of the constellations. One of those of the first magnitude is in the breast of the Lion, and is distinguished by authors under the particular names of Regulus and Cor Leonis, the other is near the extremity of the tail, it has been, by some, accounted only of the second magnitude. These distinctions are arbitrary, it is less than the other, but it is too large for the second size. One of those of the second magnitude is toward the lower part of the neck, and the other in the loins; this latter is also degraded, by some, into one of the third magnitude. Among those of the third magnitude, one is in the southern foot, another the southermost of three in the head, a third north in the head, a fourth the south of three in the neck, a fifth the north in the neck, a sixth an unformed one, (the fortieth of Ursa Major according to Tycho Brahe) and a seventh south in the hip. The rest are disposed tolerably regularly over the body, and it will not appear a wonder that a constellation, so very well marked, should be very conspicuous in the heavens.

The Greeks, who never want some part of their fabulous history to which to refer the origin of every one of the constellations, and by which they affect to place themselves with the world as the inventors of the science, tell us, that this sign in the heavens owes its origin to the famous Nemæan Lion which Hercules slew. It is no great wonder indeed that this creature should be raised up among the stars, for they tell us, that, in its origin, it dropped down from the moon. Jupiter, they say, in honour of the hero, and in commemoration of the dreadful conflict, placed it among the stars: but this is very foreign to the intent of the inventors of the constellation. The Egyptians taught this part of astronomy to the Greeks, and it was from them that they obtained the figures of the constellations, which they always retained, whatever stories they told concerning their origin. The Egyptians could know nothing of Hercules, for the constellation was formed ages before the story of the Nemæan Lion was invented. They used these figures as hieroglyphics, and they selected among the animals. Accordingly Aries, Taurus, and the two Kids, which were the original Gemini, were placed in the zodiac to mark the time of the breeding of those animals.

The

The Crab, to figure the ſun's oblique deſcent and retrogradation, the way of walking of that animal; and all that they meant by the fury of the Lion was, that the ſun, when he entered into that diviſion of the ecliptic, occaſioned furious heats. It is thus we are to underſtand the real origin of the conſtellations: all the Greek fable is impertinence.

The opinion of Leo's being the Nemæan Lion of the Greeks, and of that ſavage's having been dropped from the moon, and afterwards raiſed up to the heavens in form of this ſign, is univerſal among the antients, and we find one or other of them continually alluding to it. Seneca names it twice in this light in his Hercules Fureus.

Sublimis alias Luna concipiat feras,

and much more expreſsly,

Leo flammiferis æſtibus ardens
Iterum a cælo cadet Herculeus.

Nor did they confine this lunary origin to the Nemæan Lion, or Lion of the zodiac; the Bull, which occupies the ſecond place in the zodiac, is, by ſome, complimented with the ſame origin, and, inſtead of the father of the ſecond produce among the cattle, as the Egyptians certainly conceived it, we find ſome of the old poets giving it, as to the Lion, its birth in the moon, and its place on earth, before it was raiſed a ſecond time into the ſkies in the Dictæan field:

Taurus media nam ſydera Lunæ
Progenitus Dictæa Jovis poſſiderat arva.

The old aſtrologers, as they gave one of the twelve months of every year to each of the twelve principal deities, ſo they alſo committed to the protection of each, one of the twelve ſigns of the zodiac. The Lion was given to Jupiter, and from this ridiculous fancy has ariſen all that jargon of aſtrologers, who talk of an alliance between the planet Jupiter and the conſtellation Leo. Theſe are a ſet of writers who often confound themſelves; but when they ſpeak of any ſingle fixed ſtar as partaking of the influence, or being of the nature of any of the planets, they mean that there is a tinge of the ſame colour in the light of that planet and that ſtar. This is a nice obſervation, but there is ground for it; on the other hand, when they ſpeak of the analogy between a planet and a whole conſtellation, they only allude to this general deſignation of the ſign to a deity, of whoſe name there happens alſo to be a planet.

LEO MINOR, *or the Leſſer Lion.* One of the conſtellations of the northern hemiſphere. It is one of the new ones formed out of what were left under the name of Stellæ Informes, or unformed ſtars, by the antients, and added to the forty-eight of their conſtruction.

The Little Lion is a conſtellation of conſiderable extent, notwithſtanding that in compariſon of its great neighbour in the zodiac, it very well deſerves that epithet, and it contains a quantity of ſtars very fully proportioned to its extent, or to the ſpace which it occupies in the heavens. It would indeed be difficult to pick out a ſpace in the whole hemiſphere which is thicker beſet with ſtars than this in which the Little Lion is now placed to comprize them, although it had not occurred to the antients to put any figure there.

The Little Lion is repreſented in the ſphere in that poſture, which, with reſpect to this beaſt, is called couchant, and the figure is drawn very juſtly; he is drawn ſquatted down on his belly, with his hinder legs drawn under

him, and the fore ones protended, the head a very little raised and the mouth open; he is represented with a very bushy mane and a long tail bent down, and ornamented with a bush of hair at the end.

The Little Lion is situated between the Great Bear, the Greater Lion, and the Lynx. The space left between these is filled very advantageously by this constellation. He is placed just over the head of Leo, his breast and fore paws being at a small distance above his head, and his hinder legs over his neck. The Great Bear is placed over him as he is over the Greater Lion, the right hinder foot of the Bear is just at his haunches, the left hinder foot, which is advanced as in walking, is at a small distance over his neck; the two fore paws of the Bear are above and beyond his head, and the bent part of the tail of the Lynx is just at his nose.

The stars, comprised in the Little Lion, are, according to the account of the accurate Flamstead, fifty-three, but many of them are small, and indeed there is not one of them of the first magnitude; there are, however, several very conspicuous, and though there yet remain behind the tail a few stars which might have been better brought into it, yet those, which are comprized in the out-line, are so happily disposed, and many of them so considerable in their sizes, that there is not, in the whole hemisphere, a constellation better defined, or more easily distinguished at sight than this. The largest star in the whole constellation is a very bright one, nearly in the middle of the body by the insertion of the hinder thigh; there is also a very fine one between the knee of the right hinder leg and the bended part of the tail, which is just by it. There are five stars disposed in a curve along the lower jaw on the front part reaching to the opening of the mouth, which very happily mark the out-line in that part of the figure. There are two near the eye, one at a small distance above, and the other below it, one just on the crown of the head, and one before the mouth, and one over the left eye, both out of the lines of the drawing, but very near to them. There is one in the middle of the mane, and several about the edges of it, particularly a little cluster of three toward the middle of the back, and at the edge of the mane, in that part, which have a very pretty effect. There are a considerable number sprinkled over the several parts of the body, and that with great regularity, scarce any space of consequence being left vacant; toward the top of the haunches there are but few stars of any great size, but there is amends made in the numbers of the smaller; there are several conspicuous ones on the fore and hinder right paw, and one very fair and conspicuous at the extremity of the tail in the bush of hair. There are, in particular, five stars behind the tail, which it might easily have been made to comprehend, but they are easily to be marked as being behind that, and over the haunches of the Great Lion, and even in this there is an use in the new constellation.

LEO MARINUS. A name by which some, who are fond of uncommon words, have called the constellation Cetus. It is a name by which some of the old Latin writers called it, and to say truth, the figure is at least as like a lion as a whale. The term Sea Lion has been given but of late years to one of the large species of Sea Calf, or Phoca; if it had been an old one there would have appeared a great deal of propriety in this application of it; for the figure, tho' like no other animal in the creation, bears some sort of resemblance to that creature, having a large mouth and two fins at the breast resembling paws. But the old authors,

thors, who used the term, did it quite at random, for they have called it also Ursa Marina.

LENS. A solid, which is convex on both sides. Each side of the lens is a segment of a sphere, and they may be equal, or of unequal spheres, and the solid still determined by the same name of lens. The term is general, and expresses any solid of this figure, of whatsoever materials it is composed; but it is in a manner appropriated to a solid of this figure made of glass. All glasses of this figure do what is commonly called magnify, that is, they represent objects seen through them as if larger than they really are, and shew us their several parts more distinctly. The very small magnifying glasses used in microscopes, most regularly come under this denomination, as they most approach to the figure of the lentil, a seed of the vetch, or pea kind, from whence the name is derived; but the reading glasses, and burning glasses, and all, which magnify, come also under the denomination; for their surfaces are convex, altho' less so. A drop of water is a lens, and it will serve as one. Many have used it by way of lens in their microscopes. A drop of any transparent fluid, inclosed between two concave glasses, acquires the shape of a lens, and has all its properties. The crystalline humour of the eye is a lens exactly of this kind, it is a small quantity of a transparent fluid, contained between two concave and transparent membranes, called the coats of the eye, and it acts as the lens, made of water, would do in an equal degree of convexity. When we mention the term axis of a lens, we mean by it to express a line drawn from the middle point of one of the convex surfaces of the lens, and carried directly to the centre of the other. This line continued both ways, would pass through the centres of those spheres, of which the convex surfaces of the lens are segments. And if a circular plane be imagined to divide the segments of spheres which form the lens, that plane is called the section of a lens. When a lens is turned directly toward an object, its axis, if continued, would fall directly upon the middle point of that object.

LENKUTCH. A name by which the astrologers, and such of the astronomers, as love hard names, have called the constellation Cancer. It is its Turkish name.

* LEPUS, *the Hare*. One of the constellations of the northern hemisphere. It is named by all the writers on astronomy, and is one of the forty-eight old constellations; the knowledge of which the Greeks owed to their Egyptian instructors. But it is one of the least considerable among them, whether we regard its bigness, or the number of stars it contains, though that, in proportion to its extent, is not very inconsiderable.

Many of the creatures of the heavens are unlike to all those of the earth, and this is one of them. The designers of the constellations have as good an hand at misrepresenting nature, and making monsters, as the heralds. If it were not for the name, one would as soon take this for a tyger as an hare. As it is usually represented in these drawings, the ears are indeed long, but it is a thick-bodied animal, with long legs, and a fine curling tail. Any other figure might as well have contained the stars which belong to it, but that which should have been like an hare, would not have been the best in the world for that purpose.

The constellations, between and among which the Hare is placed, are the Great Dog, Orion, and Eridanus. The Dog is behind it, but in an odd position, he is not running upon the same plane, but almost vertical to it.

The fore foot, however, is near the hinder part of this conſtellation. Orion is juſt over it. His right foot, and a part of the right leg are behind it: his left foot, which is lifted up, and in which is the famous ſtar Regel, is juſt over the ears of the Hare, and a bent part of the river Eridanus is juſt before it.

The old aſtronomers numbered twelve ſtars in their conſtellation Lepus. Tycho gives place to thirteen; Hevelius has enlarged the number to ſixteen, and Flamſtead makes them three more, nineteen. Among theſe there is not one ſtar either of the firſt or ſecond magnitude. There are two allowed to be of the third; the one of theſe is in the middle of the body, and the other is under the belly. There are two others in the poſterior foot, which are alſo, by ſome, called ſtars of the third magnitude; but the generality of authors call them only of the fourth. There are ſome others of the fourth and fifth, and indeed of the whole number there are not more than two of the ſixth magnitude.

The Greeks, who are fond of referring the origin of every conſtellation to ſome part of their own hiſtory or fable, tell us, that this Hare was one of the creatures which Orion uſed to hunt, and that it is therefore repreſented as running away before him, but there was no ſuch thought in thoſe who deviſed the ſign. The Dog of Orion is not in a poſture of purſuing or regarding it, nor is Orion looking down upon it, tho' it is cloſe at his feet: beſide that, as others of themſelves obſerve, it was unworthy the character of this great huntſman to meddle with ſo paltry an animal. Indeed we ſee the poets of old time of a different opinion about his ſports. Horace, when he talks of his game, does not mention the Hare, but the moſt deſperate among the beaſts of prey:

Nec curat Orion Leones
Aut timidas agitare Lyncas.

It is from the ſtars of the conſtellation Lepus that Schiller, and the enthuſiaſts who followed him, have formed the conſtellation, which they call the Fleece of Gideon.

LEVIATHAN. According to Schickard, and his followers, one of the conſtellations of the northern hemiſphere, but the name is all that is new, he applies it to the Dolphin. Schiller not content with ſuch eaſy innovations, alters the figure, and makes it the pitcher of the Canaanitiſh woman.

* LIBRA. One of the conſtellations of the northern hemiſphere, and a very conſiderable one. It is one of the old forty-eight, and is alſo one of the twelve ſigns of the zodiac, or a mark of one of the diviſions of the ecliptic. Libra is not an extremely large conſtellation, nor are the ſtars contained in it very numerous; but there are ſeveral of them of conſiderable ſize, and they are diſpoſed in ſuch a manner as very ſtrongly to mark out the conſtellation.

The figures of the zodiac are in general much better drawn than the other conſtellations, ſome of thoſe are monſtrous enough, but theſe are in general very well done, and none better than this of Libra. It is repreſented in all the ſchemes of the heavens by a pair of ſcales, one of the diſhes of which is traverſed near its middle by the ecliptic, and the other, with the whole beam, is placed above it.

The conſtellations, between and among which Libra is placed, are the Scorpion, the Serpent, Virgo, Hydra, the Centaur, and the Wolf. The Scorpion is immediately behind, and the Virgo immediately before this conſtel-

constellation. The head and fore claws of the Scorpion come very close to the lower bucket, or bason of the two, and the right foot of Virgo treads upon the beam. The Serpent twists itself over one end of the beam, and the handle which is turned that way. The tail of the Hydra comes toward the scale that is on the ecliptic, and the Centaur's head, and the Wolf, are yet nearer to it, the latter coming very near to a part of the figure of the Scorpion.

The antients allowed seventeen stars to this constellation according to Ptolemy, in whose books it stands described under the name of Chelæ; for they, at that time, protended a pair of vast claws from the Scorpion into this space, and made that constellation cover two divisions of the zodiac. Tycho Brahe mentions only ten stars in Libra; but Hevelius makes them twice that number, and Flamstead raises the account to fifty-one. Of these there is one of the second magnitude, it is in the upper or northern scale toward the centre of it, and is a very bright and beautiful star. There are three of the third magnitude all very conspicuous, and several of the fourth. The three of the third magnitude are situated, one in the south scale, toward the upper part; this is so bright and large that many call it one of the second magnitude. These divisions are known to be arbitary. Another is among the informes, just below the south scale, and another under the north scale; but this is by some called only one of the fourth magnitude. Certainly there is a class difference between this and the first named among those of this kind. The rest of the stars, at least of the considerable ones, are disposed about the body of the scales principally; for there are very few in the cords or beam.

It has been generally understood, that the constellation Libra was a kind of innovation in the heavens; but there is great room to doubt whether this be the case. We find the astronomers of the several ages that succeeded one another, of whatever nation they were (the Arabians only excepted) very cautious of altering the figures under which the stars had been arranged by those who wrote before them. The Arabians were under a necessity of making certain alterations from their adherence to their religion. Their law forbade them on any occasion to draw human figures, and, in consequence, they were obliged to alter all that they found such in the heavens. They gave a mule for Auriga, and a sea calf for Andromeda, and so of the rest. But among other nations the figures have been preserved as if sacred. That Libra has been altered at some time or other is certain, and if we except the Greek vanity of converting the pair of kids of the Egyptian Gemini into their Castor and Pollux, this change in Libra is almost a single instance.

To examine it to the bottom, we shall perhaps find a pair of scales were the original figure. That the Greeks were not acquainted with any such is certain; but we find them among the Sagittaries and Capricorns on the old Egyptian remains, and according to their custom in hieroglyphical writing, it is very likely that they did place a pair of scales in equilibrium here, by way of denoting the equality of days and nights, at a time when the sun arrived at this part of the heavens. It is palpable, that we have not exactly the original meaning, for ours are thrown down in the figure, not supported in equilibrio. The Greeks, by some accident, seem to have lost this constellation in the coming over, for they found the gap, and wanting some figure for this portion of the zodiac, they lengthened the claws or forcipes of the Scorpion, and carried them into this place. Thus

it ſtood evidently with them for many ages, for all their writers mention Chelæ Scorpionis in the place of Libra. The Romans, when they grew fond of the ſcience, were aſhamed to ſee only eleven figures for the twelve diviſions of this important part of the heavens, and they cut off the long claws of the Scorpion, and in their place gave the figure of their Julius Cæſar, holding a ballance in his hand, as we ſee him repreſented on ſeveral of his coins. In after-time the figure of the emperor was thrown off, and we have retained only the ſcales; and have brought our ſchemes nearer, perhaps, to thoſe of the old Egyptians; for the ſcales are repreſented in their antiquities.

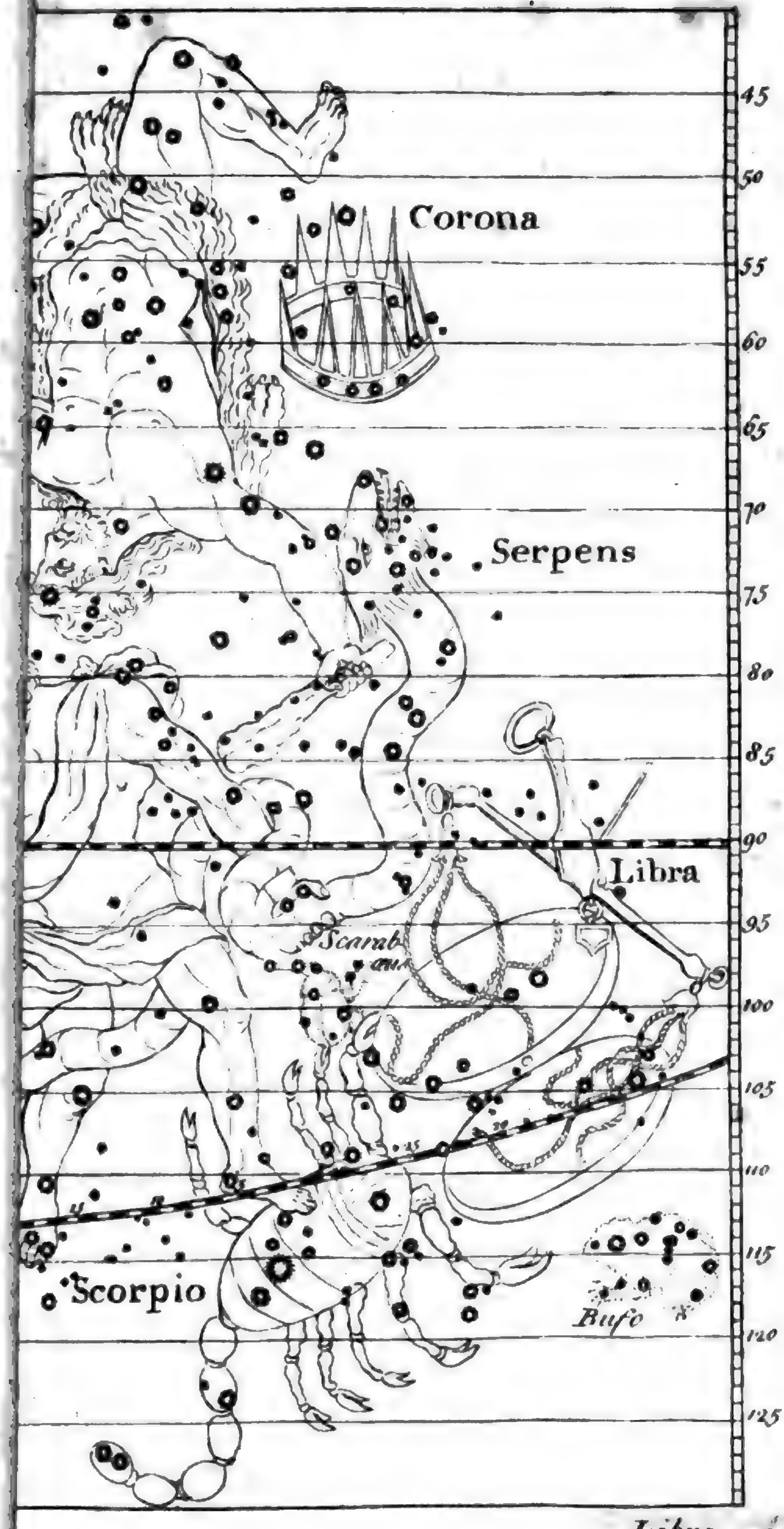
The antients, as they gave one of the twelve months in charge to each of the twelve principal deities, ſo they alſo allotted to each of them the care of one of the twelve ſigns of the zodiac. The Libra fell to the ſhare of Vulcan, and from this ſingle piece of old ſuperſtition, is owing all the jargon of the later aſtrological writers concerning it.

Libra, *the Point of.* The ecliptic or circle, in which the ſun performs what is called his annual Revolution, cuts the equator, or that great circle of the ſphere, which is at equal diſtance from each of the poles, in two points oppoſite to one another; the ecliptic being enclined to the equator twenty-three degrees, twenty-nine minutes, or there about. The ſun is ſeen in each of theſe points of interſection once in the year, that in which he appears at the time of the vernal equinox is called the point of Aries, that at the autumnal equinox the point of Libra.

LIBRATION, *of the Moon.* When we examine the body of the moon by the naked eye, as when we view that of the ſun by the aſſiſtance of glaſſes, we ſee certain ſpots on the ſurface. And if we apply glaſſes alſo to the moon, we ſee thoſe ſpots on its face more diſtinctly. One of the firſt diſcoveries, reſulting from the obſervation of the ſpots of the ſun, was, that it had a revolution round its own axis: this was evident, for that the ſame ſpot was ſeen traverſing the diſk, and diſappearing at one edge, and, after a proper time, reappearing on the other. It is not thus with regard to the moon. Whenſoever we look upon her we ſee the ſame ſpots, and we ſee them in the ſame ſituation. It is evident, therefore, that the ſame face of the moon is always turned to us; at the utmoſt this little difference is all, that thoſe ſpots, which always preſerve the ſame ſituation with regard to one another, appear ſometimes to approach a little toward the edge of the apparent diſk, and ſometimes to depart from it in the ſame little proportion.

This little difference of place had not been obſerved by the earlier aſtronomers, and even by thoſe who have ſeen it, has never been placed to the account of a revolution of that planet, nor can be; its courſe is of another kind. It was very natural for thoſe who had determined that the ſun had a revolution about its own axis, becauſe they ſaw a motion in his ſpots, to determine that the moon had no ſuch revolution, becauſe they ſaw her ſpots always in the ſame place. All that thoſe, who had diſcovered the little variation of place in the ſpots toward the edge of the diſk, inferred from it, was, that her globe was ſubject to certain tremblings or balancings, ſuch as we ſhould ſee in a bowl when we changed its centre of gravity; theſe balancings or tremblings they called *librations* of the moon.

The conjecture that the moon had no revolution about her axis, from the [illegible]nuing in the ſame place, was [illegible]


Corona
Serpens
Libra
Scarab
Scorpio
Bufo
45
50
55
60
65
70
75
80
85
90
95
100
105
110
115
120
125

was rash and hasty. Nature is very uniform in her works, and we should not agree on superficial reasons, or bare appearances, to an opinion, than in any thing she has in a particular manner departed from her course. We see the sun and planets revolving round their axis, the one as it is fixed in its place, the others as they revolve in their orbits round it. We know this earth revolves round her axis as one of them, and to that we owe our day and night: we know, that, even among the fixed stars, there are some, which, in the same manner, revolve round their axes; (this will be ascertained hereafter under the article of *new stars*) and we have all the reason in the world to believe the rest do so too. Why then should we be hasty to suppose the moon alone, of all the rest of the heavenly bodies, to want this motion? Were it not more prudent to imagine, that these little motions, which we distinguished in her, and which are so irregular in themselves, and so different from those of the other heavenly bodies, are owing to a combination of two motions, the one a revolution of the moon about the earth, and the other round her axis.

We have no occasion to wonder at the discovery of singularities in the motion of the moon; we see her different from the other planets in many respects; she is carried round the earth, and with it round the sun: the others are simply carried round the sun as the earth is. We have no reason to suppose her motions would be exactly like theirs; and the only bodies to which she has a real analogy, the satellites of Jupiter and Saturn, (to be spoken of hereafter) are too remote for the comparison.

Let us consider what would be the effect of the moon's having a revolution round her own axis, during her having a revolution monthly round the earth. This is what we ought to suppose in conformity to the laws of the other heavenly bodies; let us suppose it so then, and consider what would be the consequences. We are to consider, that there is, in the globe of the moon, in the same manner as in that of the sun, an axis, which at all times passes thro' the same spots, fixed upon the surface of the moon, at the extremities of which are placed two poles elevated eighty-seven degrees and an half above the plane of the ecliptic, and eighty-two degrees and an half above the plane of the moon's orbit. From this it will follow, that the equator of the moon, which is ninety degrees distant from either of the poles, and which also passes, at all times, over the same spots, is inclined to the ecliptic two degrees and an half, and to the moon's orbit seven degrees and an half.

In the second place, let us consider, that the poles of the moon are, at all times, in a great circle of the globe of that planet parallel to a great circle which passes through the poles of her orbit, and through those also of the ecliptic. This we may call the colure of the moon, for the same reason that great circle, which passes through the poles of the equinoctial and of the ecliptic, at the distance of ninety degrees from the intersection of those two circles, is called the colure of the solstices.

Let us, in the last place, suppose, that the globe of the moon does, in reality, turn round about its own axis with a motion from west to east in the space of twenty-seven days and five hours, by a period equal to that of her return unto the same point of the orbit, or to the node of her orbit with the ecliptic. This motion would be analagous to the revolution of the earth about her own axis, which she makes from west to east, and returns to the same colure in the space of twenty-three hours and six minutes.

 This

This is not too hard a suppofition, nor is there any thing unnatural in it, and this will perfectly explain all the varieties of the apparent libration of the moon, upon principles which fubject that planet to the fame kind of laws which have place in all the reft.

We have already obferved, that, in the globe of the moon, its poles, which are two degrees and an half diftant from thofe of the ecliptic, according to this hypothefis, are always placed upon a great circle parallel to that which paffes through the poles of the orbit and of the ecliptic. This muft be kept in mind; thefe poles ought to appear to move about the poles of the ecliptic in defcribing two polar circles, which are two degrees and an half diftant, and to finifh their revolutions in eighteen years and feven months, from eaft to weft; in the fame time, and in the fame direction, with the nodes of the moon: this muft be in the fame manner, which, according to the Copernican fyftem, the poles of the earth perform their revolution about the poles of the ecliptic, from eaft to weft, according to two circles, which are three and twenty degrees and an half diftant, in the fpace of twenty-five thoufand years. This is what caufes the appearance of a motion in the fixed ftars, about the poles of the ecliptic, in the fame period.

When we have taken notice of this, we are to confider, that the poles of the orbit, reprefented on the globe of the moon, ought, at all times, to appear on the circumference of its difk; for the centre of the moon being on its orbit, its globe is feparated into two equal parts by the plane of that orbit, which there forms a circular fection; which fection, being feen from the earth, placed in the fame plane, muft appear in the form only of a diameter, or ftrait line: this is obvious from the known laws of optics and perfpectives, and this ftrait line muft pafs through the centre of the moon. The poles of the moon, which are at the diftance of ninety degrees from all the points of this circular fection, which reprefents the orbit, muft be formed on the circumference of the difk in their proper points.

When the moon is in her nodes, the great circle, which paffes through the poles of her orbit, and through the nodes, paffes alfo thro' the centre of the moon, and forms a circular fection, which, placed in the plane and at the centre of the great circle, is reprefented by the diameter. The poles of the revolution of the moon, which, according to this hypothefis, are in a great circle parallel to that which paffes the other poles of its orbit and of the ecliptic, and interfects thofe circles at the diftance of ninety degrees from the nodes, are then on the circumference of the moon's difk, which cuts the circular fection that paffes through the nodes at right angles.

Taking the four arcs then, each of feven degrees and an half, the north and fouth poles of the moon will be at ninety degrees diftance from two diameters. Thefe two diameters will reprefent, in this cafe, the equator of the moon, which paffes always through the fame fixed fpots on her furface, appearing as difpofed in a right line.

When the moon is at the diftance of ninety degrees from the nodes, the great circle, which paffes through the poles of its orbit and that of the ecliptic, paffes alfo through the centre of the moon, and it there forms a circular fection, which, being viewed from the earth, is there reprefented by a diameter, and concurs with the colure of the moon, which we have fuppofed parallel with the great circle that paffes through the poles of the orbit and of the ecliptic. The poles of the globe of the moon may therefore be there reprefented on the diameter, and we eafily determine their fituation. When the moon is in her greateft latitude north,

north, the plane of the ecliptic is toward the south, with regard to the plane of the orbit; and the north pole of the ecliptic will be then represented on the apparent hemisphere of the lunar globe, and the south pole, which is its opposite, on the dark hemisphere, at the distance of about five degrees from the south pole of the orbit towards the north. The north pole of the moon's equator, which is seven degrees and an half distant from the pole of her orbit, and two degrees and an half from that of the ecliptic, will then be in the apparent hemisphere of the moon, and the south pole, which is opposite to it in the hemisphere, which is hid from us. The plane of the moon's equator, which is at an equal distance from its two poles, will therefore be always represented by an ellipsis: just on the contrary, when the moon is in its greatest south latitude, the plane of the ecliptic is toward the north with regard to the plane of the orbit. The north pole of the ecliptic will therefore be then represented on the hemisphere which is hid from us, and the south pole will be on the apparent hemisphere; whence it follows, that the moon's equator will appear in form of an ellipsis. In this case we shall see, that the spots, which, when the moon was in her nodes, appeared to be disposed in a right line, will appear now according to the direction of an ecliptic or oval line.

In the other situations of the moon out of her nodes, and her greatest digression from the ecliptic, the poles of her globe will be placed on parallel lines, and the circles, which represent the ecliptic and the equator, will transform themselves into more or less open ellipses, according as the moon is more or less distant from her nodes.

While the poles of the moon's globe perform their revolutions from west to east, the colure of the moon, on which those poles are placed, and which is represented by a strait line when that planet is at the distance of ninety degrees from the nodes, turns also in the same way, and transforms itself into an ellipsis, the breadth of which increases till the moon being arrived at her node, it conforms itself to the eastern edge of that planet: and as that colure, which is fixed on the surface of the moon, passes always through the same spots, it follows, that, if the moon had indeed no revolution about its own axis, we should not see these spots keep their places, but should see them pass successively from the western to the eastern edge of the moon, and return again to the same place after the return of the moon to the nodes. This is contrary to what we observe in the moon, for we, at all times, see very nearly the same surface and the same spots.

It is necessary therefore, in order to explain this appearance, that we suppose the moon has a revolution about her own poles, with an equal and uniform revolution from west to east, which, being viewed from the earth, will be, from east to west, in a direction contrary to that of her colure's apparent motion. This contrary motion cannot, however, hinder but that those spots, which are near the pole of the moon, or those parallels, which they describe, being very small, shall be, at all times, carried toward the east by the colure, in such manner, that the motion of these spots about the axis, which they perform, in appearance, westward, cannot, by any means, compensate the contrary motion; but they serve to modify the swiftness, sometimes decreasing, and sometimes augmenting it.

This compensation can never be just, except when it happens that the same arcs of the parallel make equal angles with the pole of the moon and the pole of its orbit. This is a thing that can happen very rarely, and that

when it does, varies in an inftant. It is for this reafon that this fingle caufe produces feveral balancings in longitude as well as in latitude. But, befide this, there is another caufe which greatly affects thefe balancings, and efpecially in longitude: this is, that the motions, which are made about the poles of the moon, are nearly equal in equal times; while the angles, which the motions of the colure make with the pole of the orbit, have the fame inequalities with the apparent motion of the moon about the zodiac, and thefe may arife to feven degrees and an half.

Finally, when the motion of the moon is rapid, the motion of the colure in the apparent difk of the moon, which is made toward the eaft, takes fomething from the motion of the globe about its own axis, which is apparently weftward; and when the motion of the moon is flow, the motion of the globe, toward the weft, takes from the motion of the colure toward the eaft.

The pole of the ecliptic, according to the moft fimple hypothefes, anfwers, at all times, to fome one fixed ftar, and the fame fixed ftars are, all times, on the ecliptic, or on its parallels. This is the reafon why, in the Copernican fyftem, the poles of the earth, fixed upon its furface, move round the poles of the ecliptic in twenty-five thoufand years, or thereabouts, and this in a circle, which is forty-fix degrees and eight minutes diftant from its poles. This is the real motion which forms the appearance of a revolution of the fixed ftars about the poles of the ecliptic in this fpace of twenty-five thoufand years, and makes their declination-diftance from the pole vary forty-fix degrees and eight minutes in the fpace of twelve thoufand five hundred, which is about the half of this revolution.

For the fame reafon the poles of the moon, fixed on the furface of the moon's globe, making their revolutions about the poles of the ecliptic in eighteen years and an half in a circle, which is two degrees and an half diftant, reprefent, with regard to the moon, a revolution of the fixed ftars about the poles of the ecliptic in eighteen years and an half, which makes their declination, or diftance from the pole of the moon, vary about five degrees in nine years.

LIGHT. According to the Newtonian doctrine, confifts of extremely fmall diftinct parts of matter, which, moving with a vaft rapidity, make their way into our eyes, and imprefs, upon the internal parts of them, that motion which excites in our mind the fenfation of feeing. This light, in fome cafes, comes directly and immediately from the luminous body, as that from the fun or candle, or elfe it is tranfmitted to us by means of another body, containing in itfelf no light, but receiving it from the other. This is the cafe with regard to the moon, which is an opake body, but being enlightened by the fun, the light, emitted from that luminous body, and falling upon the opake matter of which the moon confifts, is thrown back, and fcattered every way. The fame is the cafe with a looking-glafs itfelf, an opake body, but which, receiving light from a candle, reflects, or fcatters it every way. Bodies, in themfelves luminous, as the fun and candle, are continually emitting thefe particles of light; bodies in themfelves opake, as the moon and the looking-glafs, continue to reflect light no longer than while they receive it from the others. The progreffive motion of light is extremely fwift, but it is not inftantaneous, it takes fome time in paffing from one body to another. That portion of light, which falls upon an opake body at once, is called, by aftronomers, contemporary light; from this they diftinguifh

that

that which falls in ſucceſſion on it according to this motion from the other body; this they call ſucceſſive light; and any the leaſt portion of light which can be conceived to act, or to be acted upon alone, and by itſelf, is called a ray of light.

Light. Rays of light, which are of different degrees of refrangibility, when reflected from opake bodies to our eyes, do excite in us ſenſations of different colours. When all the rays are abſorbed, except the leaſt refrangible, and theſe alone are reflected to our eyes, they give us the ſenſation of red. On the contrary, when the moſt refrangible rays are alone, or only in the greateſt quantity, the reſt being abſorbed, we then ſee a violet colour. Theſe are the two extremes, and between theſe are formed all the other colours, according to the greater or leſſer degree of refrangibility in the rays of light. The rays therefore which gives us the red, are the leaſt refrangible, and thoſe which gives us the violet colour are the moſt refrangible of all the rays, becauſe the moſt refrangible are the laſt to be reflected, and vice verſa. The rays which produce the intermediate colours, as orange, yellow, green, and blue, are hence ſaid to be of intermediate degrees of refrangibility, of which theſe colours are marks.

As all light, and conſequently all rays of light, conſiſt of minute particles of matter, it is probable, that the red rays conſiſt of the largeſt particles, and the violet coloured of the ſmalleſt, and the intermediate coloured rays of particles of intermediate magnitude in different degrees; and it is no raſh ſuppoſition to imagine, that theſe rays, compoſed of particles of different bigneſs, falling from that part of the eye called the retina, exctie different vibrations, and that from theſe ariſe our ſenſe of different colours.

* LIMAX, *the naked Snail*. A conſtellation offered to the aſtronomical world, and compoſed of certain conſpicuous unformed ſtars near the foot of Orion, and under the Eridanus. It is a conſtellation of ſmall extent, and contains only a few ſtars; but ſome of theſe are very conſiderable and bright ones.

The creature, under whoſe out-line they are arranged, is the black naked ſnail, which is frequent in gardens and damp places, and is deſcribed by all the naturaliſts. The ſtars are diſpoſed principally toward the head, and toward the lower part of the body, the middle is leſs characteriſed by them.

The conſtellation Limax ſtands between Orion, the Hare, and the Eridanus. Its head comes up toward the edge of the river, at ſome diſtance from the foot of Orion, and its body falls at ſome diſtance before the head and fore feet of the Hare. The tail points at another part of the Eridanus after its firſt bend; but this is at a very conſiderable diſtance. In all this ſpace, however, there are no very remarkable ſtars, nor indeed any where elſe about it.

The conſpicuous ſtars, of which the conſtellation Limax is compoſed, are nine. Their exact places may be ſeen in the figure given in the ſame plate with that of Orion. In general they are diſpoſed as follows. There is one at the extremity of the head, one at the hinder part of it near the out-line, and theſe are both large and bright ones. A little diſtant from theſe, near the oppoſite out-line, toward the hinder part of the head, are two ſmall ſtars placed near one another, after theſe is a vacant ſpace in the figure, till toward the lower part of the body, where there is in the out-line a ſingle large and conſpicuous ſtar; a little lower than this, and at the oppoſite out-line, ſtand three in a cluſter together; the laſt, which is alſo a tolerably large

large and bright one, is at the tip of the tail.

LINE. The aſtronomer borrows this term from the mathematician, and expreſſes by it that magnitude or quantity which is conſidered as extended only in length, without connecting with this any idea of breadth, depth, or thickneſs; it ſerves him for admeaſurement, or for deſcription. In this ſenſe the word line will be found to expreſs an idea, and not any thing that is, or can be, an immediate object of the ſenſes. Since they cannot take in any idea of a line which has not breadth as well as thickneſs; but in the mind's eye it does very well, and is perfectly underſtood; it is alſo beſt underſtood, and beſt applied thus, becauſe we confound ourſelves in nice diſquiſitions, by adding ideas which are not neceſſary to the ſubject.

If we draw a line upon paper, in order to make it viſible to the eye, we give it breadth, and according to the fineneſs of the ſtroke it has leſs of this, but ſtill it has ſome: take that away, and the eye can no more perceive, than the pen could make it. But from the paper let us raiſe this line into an object of the underſtanding, let us conſider it as extended from one body to another, and we no longer find any idea of breadth neceſſary. In this conſideration it ſerves for the meaſuring the diſtance of one of thoſe bodies from the other, from the one to the other of which it is extended, and breadth is not neceſſary to this, only length. When we add breadth to it, be that ever ſo little, we complicate the idea; it is then no longer a line, but a ſuperficies or ſurface. The aſtronomer uſes a line in its proper ſenſe to meaſure the diſtance of one ſtar from another; to this purpoſe he imagines to himſelf a line drawn from one of thoſe ſtars to the other, and in this line he does not conceive any breadth, nor any thickneſs. All the uſe to which he puts it is to meaſure the diſtance, and this may be done without breadth or thickneſs in the line, which ſerves as the means of meaſuring, ſince for this purpoſe there is only required length. This is a general deſcription of a line, conſidered as a line, as quantity extended in length only; but although we deny to this line either ſurface or ſolidity, either depth or breadth, its direction may ſtill vary, and according to this variation the aſtronomer conſiders it under ſeveral new names, or terms, expreſſing the difference. Thus it may be either *ſtrait* or *crooked.* The firſt is called a *right line*, the ſecond a *curve line*, or *curve.* The ſtrait line is limited to no bounds in its extent length-wiſe. We may conceive it as extended from the middle both ways to any given diſtance, and meaſuring the diſtance we have the length of the line; but as ſpace is unlimited, we may alſo conſider it as extended without bounds. In this ſenſe it is called an indefinite line, or by ſome an infinite line. To talk like a geometrician, it would be eaſy to extend the conſideration of a line under a thouſand other denominations, and as many figures and relations; but this will be ſufficient for the underſtanding it, as uſed by the aſtronomer.

Line is alſo a term by which our ſailors, and after them ſome writers, call the equator. This is a circle ſuppoſed to be drawn round the earth, at equal diſtance from the two poles, and conſequently to divide the earth equally into a northern and ſouthern hemiſphere. When a ſhip ſails over this they call it croſſing the line.

LINES. A term under which are compriſed fourteen ſtars, ſituated between the two fiſhes in the conſtellation Piſces. Five of theſe are reckoned in the northern, and nine in the

ſouthern

ſouthern line. There is a bright ſtar that ſeparates theſe, it is called the Knot. *See* PISCES.

LINES, *parallel.* They are two lines running at equal diſtances.

LINON. A name by which ſome, who are fond of unuſual words, call that part of the conſtellation Piſces, which conſiſts of the cord or ſtring that ties them to one another; others call it Hermedone, Syndeſmus, and Arpadone. They are all Greek names.

LION. One of the conſtellations of the northern hemiſphere, and one of the twelve ſigns of the zodiac. *For an account of its ſtars, ſee the article* LEO.

LION, *little, the Little Lion, or Leſſer Lion.* Leo Minor is one of the new conſtellations of the northern hemiſphere, which Hevelius added to the forty-eight old ones, forming them out of the Stellæ Informes, or Unformed ſtars. This ſtands between the Great Lion and the Great Bear, and contains a very conſiderable quantity of ſtars. There is indeed hardly any ſpace in the hemiſphere more thickly ſprinkled with ſtars than this, which was for ſo many ages left unoccupied, and in which the Leſſer Lion is now placed; yet even this does not take in ſo many as might have been wiſhed of that unformed number, though it tolerably well fills the ſpace. *See the article* LEO MINOR.

LITRA. A name by which ſome call the conſtellation Libra. It is one of its Greek names.

LIZARD, *Lacerta.* One of the new conſtellations of the northern hemiſphere. It is one of thoſe which Hevelius added to the forty-eight old ones, having deſigned them out of what were called the unformed ſtars in the other catalogues. The Lizard is placed near the tail of the Swan, and contains ſixteen ſtars. *See the article* LACERTA.

LONGITUDE. The favourite method of finding the longitudes of places, by the obſervation of the ſame phœnomenon in the heavens, in remote parts of the world, is owing to this principle, that a certain number of degrees on the great circle of the earth, anſwering exactly to a certain portion of time, the diſtances may be counted as well by the time as by the meaſure of ſpace. In this computation we are to allow fifteen degrees to an hour, for that is the proportion, and all the reſt is eaſy.

The hour circles, and the hour ſemicircles, by the attention to which this admeaſurement is made, are on this principle. We are to conceive, in the firſt place, twelve great circles, ſo diſpoſed, that they ſhall divide the equator equally, that is, into twenty-four equal parts, all of them paſſing through the two poles of the earth, and one of the twelve being the meridian of ſome given place. Theſe are the hour circles, with reſpect to that place, the meridian of which is one of them, and as every meridian is divided by the two poles of the earth into two ſemicircles, ſo theſe twelve are by thoſe two poles, through both of which they paſs, divided into twenty-four ſemicircles. Now if we compute the parts of the equator, as divided into three hundred and ſixty degrees, like all other circles, we ſhall find that fifteen is a twenty-fourth part of this whole three hundred and ſixty, and conſequently the equator being, as already obſerved, divided into twenty-four parts by theſe circles, each of theſe diviſions muſt contain a ſpace equal

to

to fifteen degrees, or to a twenty-fourth part of the hundred and sixty. Therefore, in other words, an arc of the equator, contained between any two of these hour semicircles nearest to one another, is fifteen degrees. This is the great admeasurement, and from this all the rest follows.

We know that the rotation of the earth, or her revolution, on her own axis, is performed from west to east, and consequently the places of these hour semicircles will, by that rotation, be brought one after another to point directly at the sun, and this in the course pointed out by that rotation. Now each of these being of fifteen degrees distance from that which is nearest to it, and an hour in the periodical revolution of the earth on her axis, being equal to fifteen degrees, the plane of every one of them will be brought to point directly at the sun an hour after the plane of that semicircle which is next to it toward the east, has pointed directly at the sun: and this will be the case exactly in the same manner with respect to the fixed stars, and to the other in the heavens. The whole twenty-four meridians, of which that of the place is one, will thus pass over the centre of the sun in the course of a natural day, and this at the exact distance of an hour from one another; their distance from one another being fifteen degrees, and fifteen degrees being an hour in this manner of admeasurement: and after a succession of the whole series, the earth will punctually, at the return of the same hour the next day, come to the same place in the meridian, and the hour circle, which before pointed at the semicircle, again directly point at it. And the meridian of any place is brought to point directly at the sun, sooner or later than that of the given place, by a time exactly proportioned to its distance, an hour, if it be fifteen degrees, and more than an hour, or less than an hour, exactly in proportion, as it is more or less than fifteen degrees distant.

The use of these hour circles, as appropriated to the divisions upon the equator, is therefore very evident; and as they express certain equal divisions upon the equator, the longitude of places may be as well set down as by the common form of degrees and minutes. And thus, whatsoever be the given place, or the occasional first or great meridian, the distance of any place from that in time, or the longitude of that place expressed in time, is the number of hours, minutes, and seconds, by which the meridian of that place is distant from that of the other. Thus, if we suppose this city of London to be the place, whose meridian is one of the twelve equal circles that are the hour circles of the division, if we look at any place, whose meridian is forty-five degrees distant to the east upon the equator, we shall find, that the sun is directly over the plane of the meridian of that place exactly three hours before it is over the plane of that of London, because fifteen degrees are equal to an hour; and there are three times fifteen in five and forty. Now if we have a mind to say what is the longitude of this place, we may with equal propriety, and equal accuracy, describe this by time, or by space; for if we say, that this place is in distance five and forty degrees east of London; or, if we say, that it is three hours east of London, the meaning is the same, and it is as accurately conveyed as if we spoke by the number of degrees, every one knowing that fifteen degrees space, and an hour's time in the revolution of the earth, on her own axis, are equal. And as hours may be divided into minutes and seconds, as accurately as degrees, the measure is not limited to round numbers, or even distances, but serves as well for the

irregular

irregular or unequal. In this caſe we may either continue the meaſure of the diſtance eaſtward all round the globe, and admit no other terms; or, with reſpect to places that lie not very remote to the weſt of the given place, we may count both ways. It will be plain, that the hours will ſerve for this purpoſe, as well as the degrees. For if any place be at thirty degrees weſt of London, the ſun will there come to the meridian juſt two hours later than it does at London, the hours and degrees being, in this reſpect, commenſurate; and to expreſs that diſtance we may as properly ſay, that the place in queſtion is two hours diſtance in longitude weſt from London, as ſay, that its longitude is thirty degrees weſt of that place.

Now with reſpect to finding the longitudes of places by time, it follows very plainly from theſe obſervations. For if two perſons, in two remote places, obſerve any inſtantaneous appearance in the heavens, and after compare their obſervations, the time at which this was ſeen at each place, will give the diſtance of thoſe two places in longitude, becauſe it is very plain, by the before mentioned obſervations, that every hour of time anſwers to fifteen degrees in meaſure, and conſequently every part of an hour to ſo many proportioned degrees, or parts of a degree.

It is not neceſſary to this purpoſe, that the two places where the obſervation of the appearance in the heavens is made, ſhould be in the ſame parallel, or at equal diſtance from the equator; for it is a firſt principle in the doctrine of meridians, that all places, which lie under the ſame meridian, have the ſun at the ſame moment, and this is extended to all other obſervations of the heavenly bodies; ſo that the ſame inſtantaneous appearance in the heavens, be it what it would, muſt be viſible at the ſame moment in all places under the ſame meridian; and hence when the meridians of the two places, in which the obſervation was made, are brought down to the equator, the diſtance of hours and minutes in the obſervation, being reduced to degrees and minutes, at the eſtabliſhed rate of fifteen degrees to a minute, gives the difference of the two meridians in meaſure: that is, in other words, it ſhews what is the diſtance of the two places in longitude. So that ſuppoſing the appearance in the heavens an eclipſe of the ſun, the moon, or but of one of the ſatellites of Jupiter, there requires no more than the hour of the day at which it began, was central, or ended; at each place, to be able to determine exactly the diſtance in longitude of the two places. Thus, if the moment of the beginning of an eclipſe was at London, ten o'clock at night, and by accounts from the obſervers in two other places, it appears, that the moment of the beginning was in the one at nine o'clock, and in the other at midnight, it will be very plain, that whatſoever the place was where it was at nine o'clock at night, that place is exactly an hour diſtant, that is, it is exactly fifteen degrees diſtant in longitude eaſt of London; for an hour, according to the doctrine of the hour circles, is juſt equal to fifteen degrees: and as to the other place where it began at midnight, that being two hours later than the moment of its beginning at London, it will be very plain, that this place is thirty degrees diſtant in longitude weſt from London, two hours being equal to thirty degrees; and thus the computation may be made in broken numbers with great exactneſs, and with great eaſe. For it will appear, that the number of minutes in an hour, and the number of minutes in a degree being the ſame, and the hour being equal to fifteen of the degrees, every minute of an hour muſt be equal to fifteen minutes

nutes of a degree, and every second of time to fifteen seconds of measure. The quantities being thus known, the calculation may be made by the common rules of arithmetic.

Longitude is also one of the two terms under which the situation of any place, upon the surface of the globe, is described and ascertained; the other is the latitude, and they will be most naturally explained together. In order to ascertain the situation of any place, there must first be a settled part of the earth's surface from which to measure, and as the place to be ascertained may lie in any part of the surface of the earth, that surface being spherical, the place from whence to measure must be a circle. When one such circle however should be established, it would still only shew the distance of the place to be ascertained one way, or in the direction of right or left of that circle, there would still be no way of guessing at its situation forward or backward, with respect to any other place. It was therefore found necessary to fix upon a second circle which should intersect the other, and in consequence of these the situation of any place might be ascertained with respect to every direction, or its absolute seat on the earth's surface known.

The first of these circles depended upon the poles of the earth. It was found, that the earth revolved about its own axis, or about an imaginary line drawn through its centre. This imaginary line must touch the surface of the earth in two opposite points. These two points are called the two poles of the earth, and the first circle mentioned is that drawn round the whole earth at equal distance from these two points; this circle is called the equator. This being fixed in its place by its equal distance from the poles, gave the first division of the earth, and the first grounds for measuring the distance of places. The whole surface of the earth was by this divided into two hemispheres, the one a northern, that in which the north pole was, the other, in which was the south pole, the southern. This circle was the first standard by which to measure the distance, or ascertain the situation of places, for as they were to the north, or to the south of this, more or less, they were said to be wide of it so much, or in so much north or south latitude.

This, however, only answered one of the two requisities for measuring and ascertaining the situation of places, it remained to fix another circle, which, intersecting this, should be a means of measuring the other way. This purpose is answered by what is called the meridian. The equator, or place, from whence to measure latitude, is but one circle, but the meridians are innumerable, for any circle that goes through the poles of the earth cuts the equator, and is the meridian of that place which lies under it, or of all these places which lie in a line with one another in this respect, and so are all under it. Out of the great number of these circles that might be conceived to be drawn upon the earth's surface, it remained to select some one which should be the standard of measure in the opposite direction to that from the equator. The Greeks fixed upon the meridian which passed through the island of Hera, (that is, Teneriffe) for this purpose, because, being the most remote part of the world westward that was then known, it was the most proper place for the beginning of their account who measured only east; others have fixed upon the meridian which passes through Corvo, one of the Azores islands; others that which passes over the extreme coast of the western ocean; and the generality of the moderns that which passes through the place where they live.

Whichsoever of all these is fixed upon for the

the first, the fixed, or the great meridian, it becomes a circle cutting the equator, and is the standard from which to begin the measure in the other direction. Now as the measure from the equator, north or south, is called latitude; the measure from the first meridian, east or west, is longitude. The latitude of any place therefore is its distance, north or south, from the equator measured in degrees, minutes, and seconds; and the longitude of a place is the distance of that place from the first meridian measured in degrees, minutes, and seconds, and by the joint measures the situation of the place is ascertained.

To understand this measure by degrees, minutes, and seconds, we are to observe then, that the measures are all taken with respect to some proportion to the general quantity of the earth's circumference; and that as these circles of the earth are the standards from which to measure, so they also give the means of measuring.

Every great circle is understood to be divided into three hundred and sixty parts; and each of those parts is a degree. Each degree is again divided into sixty parts, which are called minutes, and each of these minutes into sixty others called seconds, and so on, continuing the division by sixties, but more than these are not often used. Now supposing the equator to be thus divided, and the divisions marked upon it, and the first meridian in the same manner divided, and its divisions marked, nothing is so easy as to bring any place to the measure; for the distance in longitude is so many degrees in distance from the meridian measured on the equator, and the distance in latitude is so many degrees from the equator, measured on the meridian. These may both be done by means of astronomical observations at any one place, and consequently the absolute situation of any place on the globe known.

Thus we shall find, that, of the number of places, which lie under the same meridian, they have all the same longitude at whatsoever distance they may be from the equator, and, this meridian, as it passes on one side or on the other of the first or great meridian, is said to have its longitude so many degrees east or west of that meridian, which is fixed, and serves as the standard of measure. This was not the method among the antients, for they measured only one way, that is eastward, for which reason they fixed what they called their first meridian, or the standard from which to begin their measure, in the most western part of the world which they knew. We, fixing it any where at pleasure, to save the trouble of going quite round the globe, and the perplexity of using larger than necessary numbers, measure each way from it; therefore, although we read, in the writings of our astronomers and geographers, of so much longitude east, and so much longitude west, as, with respect to the equator, of so much latitude north, and so much latitude south; when we look into the antients we are to expect no such thing, they always speak of longitudes singly, and without distinction of direction; and we are to understand them, under that name, as speaking of distances east of Hera, for they meant no other.

With respect to the latitudes of places, they are determined by, or confined within, circles parallel to the equator; for although all the circles, which surround the globe of the earth between the poles, are not called equators, as all that surround it, passing through the poles, are called meridians, yet such circles there are conceived upon the earth, and there may be as many of them as the person who treats of them pleases. These are to encompass the whole globe of the earth, and are to be in every part, or equal distance from the pole, and from the

 the

the equator. Circles, thus drawn, are called parallels, or parallels of latitude, and they, in this respect, also answer to the meridians, that as all places, which lie under the same meridian, are in the same longitude, so all places are in the same degree of latitude, which lie under the same parallel.

From this doctrine of the longitudes and latitudes of places, depending upon the meridians and parallels drawn round the globe, arises this accidental information, that the earth is spherical, for if it had not been told before to the person who should be informed of this system of longitudes and latitudes, he would discover it as a consequence. It is very palpable, from the course of the two different meridians in their coming in succession after one another, to point at the sun, that the earth is round from east to west, and in the same manner, from the elevation of the pole in different places under the same meridian, it is evident, that the earth is round from north to south; from both it appears, therefore, that the earth is round every way.

Astronomers express, by the term longitude, the distance between the point of Aries and the point of the ecliptic, to which the circle of latitude, carried through any star, corresponds, and they count this distance from west to east. Geographers, by the term longitude, express the distance of any place on the surface of the earth from the first meridian, measured on the parallel of the place. This first meridian being fixed at pleasure, most people make it pass through the pike of Teneriffe; some through the most westerly of the Canary islands.

LOST DAY. A term which we find used in astronomical and geographical writers, to express the time in the course of a year which would be lost in consequence of the difference of meridians, and the earth's revolution, to the man who should set out from any place, and go eastward round the earth till he returned to the same place. This has an odd sound, but it will be easy to shew that it is what must happen in such a journey. They use the term of the Gained Day also to express that time which would be, in the same manner, gained by him who should go round the earth westward, for the hour circles dividing the equator into twenty-four degrees, and the hour being equal to fifteen degrees, this is what must, in the compass of the whole earth, happen to him who passed over, in one or the other direction, the twenty-four meridians that are at fifteen degrees distance each from the other.

This follows from the doctrine of meridians. It being apparent that the sun comes to the meridian an hour sooner at a place fifteen degrees east of any given place, than it does at the place given; that is, it is noon an hour sooner at every place fifteen degrees advanced to the east, than it was at the place then fifteen degrees distant. If we suppose, therefore, a man to be sent from London due east, and conceive him to make a journey round the whole earth till he return to London again, we shall find, that, it being noon at twelve o'clock by his watch at London, it would, by the same watch, if it kept an exact account of the time, be noon at eleven o'clock when he was at the place which is fifteen degrees in east longitude from London; and, counting thus, it would be noon at thirty degrees distance when it was but ten o'clock by his watch; at fifteen degrees more east it would be noon, when it was but nine by his watch, than when it was but eight, seven, six, and so on to midnight, and to the hour of noon again, an hour being the distance of every fifteen degrees: so that, having gone the whole round of the four and twenty, in the passing the three

hundred and ſixty degrees, which meaſure the whole earth, he would have at length found, when he was at London, that it was again noon at twelve o'clock, and that he would juſt have loſt a day, or, he would find it only Friday with him, when it was Saturday with thoſe who had ſtaid at London, and kept a regular account.

In the ſame manner, if another ſhould ſet out from London, and travel weſt, to go round the whole earth, he would find, that, if it were noon when it was twelve o'clock by his watch at London, when he had got fifteen degrees weſt, it would not be noon till it was one, at fifteen degrees more it would be two by his watch, when the ſun came to the meridian, or it was the true noon of the place; and, in this manner, he would have paſſed over the midnight in which it would have been noon at the Antipodes, and have come back to London when it was juſt twelve o'clock by his watch at noon again; having, in this manner, gained a day in the courſe of his journey, and finding it Thurſday with him, when it was Wedneſday with thoſe who had remained in London, although he had kept ever ſo regular an account of the time.

This ſuppoſes a watch to keep its time exactly during the courſe of ſuch a journey, and in this caſe the traveller, knowing the correſpondence between the meaſures of time and ſpace, would know at all times in what longitude he was, only by obſerving the time by his watch at which the ſun came to the meridian, and the advantages would be very palpable.

In the making this journey round the earth, it is not neceſſary that it ſhould be done at the equator, and go ſtrait forwards; for it being known that all places, under the ſame meridian, have the noon at the ſame hour and minute; it is all one through what part of the twenty-four hour circles, or twelve meridians, of which that of the given place is one, the journey is purſued.

LUCIDA CATHEDRÆ. A ſtar in the conſtellation Caſſiopeia. *See* LUCIDA CASSIOPEIÆ.

LUCIDA CASSIOPEIÆ. A name by which the aſtronomical writers have called the largeſt and brighteſt ſtar in the conſtellation of Caſſiopeia; it is of the ſecond, or, as others will have it, only of the third magnitude, (for theſe things are very arbitrary) and is ſituated in the back of the Chair. Hence ſome have called it Lucida Cathedræ; it is ſomewhat larger than the bright ſtar in the breaſt of that conſtellation. *See the article* CASSIOPEIA.

LUCIDA CORONÆ. A name by which aſtronomers have called a bright ſtar of the ſecond, or, as others make it, of the third magnitude in the Northern Crown; a conſtellation placed between Bootes, Hercules, and the Serpent. *See the article* CORONA BOREALIS.

LUCIDA LYRÆ. A name given by many of the antient writers to a ſingle ſtar, a very bright one, in the ſhell of the conſtellation Lyra; it is of the firſt magnitude, and is in the rim of the ſhell, on that ſide which is next to the conſtellation Hercules. *See* LYRA.

LUMBRICUS. A conſtellation offered to the aſtronomical world, and compoſed of a ſeries of conſpicuous and unformed ſtars between the ſigns Cancer and Gemini. The creature, under the out-line of whoſe figure theſe are arranged, is the common earth-worm, or dew-worm, which we ſee coupled above the ſurface of the ground in damp mornings.

It is a ſmall conſtellation, and it comprehends only a few ſtars, but theſe are in ſo remarkable a place that it is very fit they ſhould be aſcertained within the lineaments of ſome figure. The creature, that is made to anſwer this purpoſe, is drawn in a crawling poſture, a little convoluted, and running up from the Little Dog to Gemini.

Theſe are the three conſtellations between which it is placed, its head is very near the ſhoulder of one of the twins, the greater part of its body runs up between that ſign and Cancer, and the lower, or bent part of the body toward the tail, runs over the back of the Little Dog, and that but at a ſmall diſtance.

The conſpicuous ſtars, in the conſtellation Lumbricus, are nine, and they are of very different ſizes, though none of them of the larger magnitudes. There is one at the extremity of the head, this is very near the ſhoulder of one of the Twins; at ſome diſtance below this is a ſingle ſtar in the middle of the neck; a little lower than this, at the thickened part of the Worm, there are three ſtars, two on the one, and one on the other out-line. At a diſtance, below theſe, there are two ſingle ſtars alſo on the out-line; and finally, there are two others at the end of the bended part, the one of theſe is at the very top of the tail, and the other is a little before the tip. Theſe ſtars are very well compriſed within the out-line of the figure, and there is yet this farther advantage, that there is no conſpicuous ſtar any where about it that is left unformed ſo as to create confuſion.

LUPUS, *the Wolf.* One of the forty-eight old conſtellations; it is but of ſmall extent, and contains only a few ſtars; by many it is made only a part of another conſtellation, and is given to the Centaur, who is then called Centaurus cum Lupo, the Centaur with the Wolf, and is conſidered only as one aſteriſm. They ſuppoſe the creature, in the hands of that figure, a victim for the altar, which ſtands underneath, and on which they ſuppoſe he is about to offer it, and as a wolf was not the moſt common animal in the world, on ſuch an occaſion they are divided about the name, and while ſome have expreſsly called it by this name, others have only diſtinguiſhed it by the appellation of a beaſt in general. It is hence that the conſtellation Lupus is ſometimes called only Fera.

Its figure, as repreſented in the ſchemes of the heavens, agrees however, in ſome degree, with the denomination Lupus; it is repreſented as held with its belly upwards in the left hand of the Centaur, who has in his right an inſtrument to kill it. The head is large, the ears moderately long, the mouth open, and the legs, in ſome degree, drawn up.

The conſtellations, between and among which the Wolf is placed, are Scorpio, Libra, the tail of the Hydra, the Centaur, and the Altar. The Scorpion's legs come ſideways, almoſt cloſe to his head, the Balance is at ſome height above it; the tail of the Hydra has its tip nearly over the centre of the Wolf's belly, but at ſome diſtance; the Centaur has it in his hand, and the tail comes to his breaſt, and the Altar is beneath it under the middle of the back, but alſo at ſome diſtance.

The antients counted nineteen ſtars in the conſtellation Lupus; Ptolemy ſets down ſo many, and he is a follower, and a very ſtrict one, of Hipparchus; Flamſtead has raiſed the number to twenty-four. Of theſe the moſt conſiderable is placed juſt under, or, as the ſituation of the creature is, it may be called over the belly, and the greateſt part of the others are toward the belly, and upon or among the legs.

The

The Greeks, who are for making all astronomy the produce of their own country, tell us, that the Centaur, who has the Wolf in his hand, is Chiron the tutor of Achilles, and that the Wolf is just going to be offered up on the Altar in the piety of the good Centaur. Others make the figure Pholos, and they suppose he is about to kill the Wolf in order to inspect its entrails, for this Pholos was famous at divination. *See* CENTAUR.

LURA, OR AL LURA. A name by which some, who are fond of uncommon words, have called the constellation Lyra; it is one of the Arabic names of that sign, and is formed of the Greek word.

LYNX. A constellation of the northern hemisphere, and a very fair and conspicuous one, but it is of modern invention; it is one of those new constellations which Hevelius has added to the forty-eight old ones, and which he formed out of the Stellæ Informes, or, as they are called, the unformed stars, which, although not comprised under the out-line of the old ones, used to be accounted to one or other of them.

The Lynx is a tolerably large constellation, and it comprises a considerable number of stars. It is represented, in the schemes of the heavens, under what is called a figure of that animal, but it is not very well drawn. The Lynx is the Lupus Cervarius, or what is usually called the Ounce, and is of the leopard or panther kind, a robust animal with thick legs and a deep fur, but it is commonly drawn naked, and with the legs of a greyhound. The true figure would full as well contain the stars, so that we have seemed to profess our unacquaintance with nature in the drawing. It is represented in a strange posture rampant, or half erect, and with a tail of a great length, naked all the way, but with a bush of hair at the end

L Y

like the lion's. This, however, is [illegible] without its use, though out of nature, [illegible] contains a star which is very fair and conspicuous.

The constellations, among which the Lynx is placed, are Cancer, the Little Lion, the Great Bear, the Camelopardal, Auriga, and Gemini. The hinder feet of the Lynx are just over the great claw of Cancer, the back part of his tail comes just to the nose of the Little Lion, the Great Bear is behind it, the fore paws of that figure falling almost upon the haunches of this; the fore feet of the Camelopardal are near the head of the Lynx, its head is over the head of Auriga, and its fore feet come almost upon his right shoulder. Gemini, in fine, is at a small distance under the belly. There is a considerable space left in the heavens among these old constellations, and this new one very happily fills it, and comprehends a fair quantity of stars. Hevelius, who formed the constellation, made these to be only nineteen, but Flamstead has raised the number to forty-four.

Among all these there is not one of the first or second magnitude, but there are some considerable enough to be very conspicuous. One of the most remarkable of these is situated just at the nose of the constellation, and there are two others larger than the rest upon the head; there is also another conspicus one in the right shoulder, and one just over the middle of the back, and two of very bright appearance at the end of the tail. One of these is, as already observed, in the bush at the end, and the other a little above it.

The rest of these stars are disposed without much regularity over the figure. There are more on the head than on the whole body, and there is a pretty cluster of about four just behind it; there is one in the centre of the neck, two or three on the belly, very few conspicuous ones on the sides or haunches, and only

two,

two, beside those already mentioned, in the whole length of the tail. Indeed more than half of the number of which the constellation is composed, according to Flamstead's account, are too small to be easily seen. Those counted by Hevelius are most of them very obvious, and the world is much obliged to him for reducing, into some sort of form, so considerable a number of stars as were in this before unoccupied part of the hemisphere. There are still a considerable number of unformed stars behind the head of the Lynx, and before the mouth of the Great Bear, which it is pity the new figure was not made to comprehend.

*LYRA, *the Harp.* One of the constellations of the northern hemisphere; it is one of the old forty-eight, and is named, by the most antient writers on astronomy.

Lyra is a small constellation, and contains but a very moderate number of stars; it makes a very inconsiderable figure in the heavens in proportion to the vast Hercules, and the other figures which comprehend the stars about it.

It is represented by a figure, supposed to be that of the antient Grecian Lyre, very different from the form of our harp; it has for its base a kind of shell, over which those who have drawn the oldest figures of the constellations have thrown a kind of curtain, from the extremities of this shell, on the upper part, arise two arms, resembling the horns of some animal, largest at the base, twirled back at the top, and wreathed all the way. Toward the upper part there is carried a transverse bar from one to the other of these, and from this to the shell are drawn five strings. This is the figure of the antient Lyre, as represented in the draughts of this constellation, and it tolerably well holds the stars that belong to it.

The constellations round about the Lyre are Hercules, the Dragon, the Swan, the Fox and the Goose. Hercules has his left hand so near it that it has been supposed to belong to that constellation, and the figure has been called Orpheus and Thamyris, instead of Hercules; the head of the Dragon being at the foot of Hercules, is at some distance below the shell of the Lyre; the neck of the Swan runs very near the left arm of the Lyre, and the Goose in the Fox's mouth, is at a small distance over the top of it.

All the old writers have named the Harp: Hipparchus, who published the first catalogue of the fixed stars, an undertaking, as Pliny calls it, for a god rather than a mortal, counted ten in the constellation Lyra; and we see the same number set down for it in Ptolemy's catalogue. Tycho has added one; he sets down eleven. Hevelius has farther advanced the number to seventeen; and our accurate and discerning Flamstead makes them twenty-one.

Of this small number there is one of the first magnitude, this is situated in the rim of the shell about the middle of its height, and on that side which is toward Hercules, this is called Lucida Lyræ, the Lucid Star of the Lyre, and sometimes Lyra, a custom the Greeks had of naming a single star that was very conspicuous, by the name of the whole constellation, the rest are small; there is not one of the second magnitude, and only a few of the third. Two of the larger among the others are toward the top, one in the arm next Hercules, and the other in the cross bar, and there are two little ones near them, and very near to one another toward the end of the bar, and one unformed one just over the great one in the bar, the greater part of the others are in the shell, or about the strings.

The Harp is a very old constellation, and probably was brought out of Egypt into Greece

Greece at about the time of Thales; but that nation, ambitious to ſink the origin of the conſtellations, that they might be ſuppoſed themſelves the inventors of them, have claimed the conſtellation as their own, and adapted to it a part of their own hiſtory: in this however they betray themſelves, for they do not agree what part that ſhall be. It has already been obſerved, that they ſometimes called it the Lyre of Theſeus and Thamyris, and called the conſtellation by that name, which is the Hercules of the preſent ages. The moſt received ſtory of its origin however is, that it was the Lyre of Orpheus, received into the heavens after his death; and among thoſe who have given it this origin, ſome have ſuppoſed the kneeling figure, before which it ſtands, not to be Hercules, but Orpheus its maſter, ſupplicating the bacchanals juſt before his death: this however has been afterwards over-ruled; and the great figure has been determined to Hercules; the Lyre has yet been called the Lyre of Orpheus, and it is as ſuch mentioned in all the Pagan ritual. They ſay, that this Lyre was originally the work of immortal hands. They tell us, that Mercury made it out of the ſhell of a tortoiſe, and that it was given to this ſon of Calliope, as the moſt worthy ſo divine an inſtrument. It is by the ſound of this inſtrument that he is ſaid to have tamed wild beaſts, and ſoftened Pluto in his requeſt for his dead wife; they make this journey fatal to him, however proſperous in the appearance. In his ſong before Pluto, which was in honour of the gods, they ſay he forgot Bacchus, and in revenge for the affront that deity ſent in the bacchanals upon him, who tore him to pieces. The muſes, they ſay, got together the mangled parts of the body, and buried them, and that with the approbation of Jupiter and of Apollo, they carried up the Lyre to the heavens, and made it this conſtellation, which we ſee in the northern hemiſphere.

* LYRA. The largeſt ſtar in the conſtellation Lyra is often ſingly expreſſed by this name.

We find Manilius giving the origin of Lyra wholly to the Lyre of Orpheus, and that in an extremely beautiful and poetical manner; in one place he makes it, as Milton expreſſes it,

Lead, in ſwiſt dance, the months and years,

telling us, that as trees and ſtones and ſavages followed it while in the hands of the divine artiſt on earth, ſo now it is advanced to the ſkies, the reſt of the conſtellations are led on by its muſic; and, in another place, ſpeaking of its power while on earth, he ſays,

Qua quondam ſonitumque ferens Æagrius Orpheus
Et ſenſus ſcopulis, et ſylvis addidit aures,
Et diti lachrymas, et morti denique finem.

We find, in the ſame manner, many of the other poets celebrating it.

LYRE, *the Harp, Lyra.* A conſtellation in the northern hemiſphere. *See* LYRA.

M.

MAADIM. A name by which ſome of thoſe writers, who are fond of uncommon words, have called the planet Mars; it ſignifies properly blood or bloody. It is one of the Hebrew names of the planet, and probably was given it from its red colour.

MAAZEIN. A name by which thoſe, who are fond of hard words, call the two bright ſtars in the arm of Auriga; it is an old Arabic name for them, and ſignifies two young goats. Theſe ſtars are the famous Hædi of the old poets, ſo terrible to mariners.

MARATZ. A name by which ſome, who love uncommon words, call the planet Mars; it is one of the Hebrew names of that planet, and ſignifies properly powerful.

MAGDALEN. A name given by ſome fantaſtical people to one of the three great ſtars in the tail of the Larger Bear; they call this conſtellation the Bier of Lazarus, and they make the four ſtars in the body of the Bear repreſent that inſtrument, and the three in the tail to be the three mourners; that next the body is called Mary Magdalen, the middle one is Martha, and the laſt her maid. They call all the three Filiæ Feretri Majoris.

MAGELLANIC CLOUDS. Certain parts of the heaven, reſembling the Milky Way. *See* CLOUDS.

MAGI. A name given by Schiller, and his followers, to a conſtellation which they have eſtabliſhed in the northern hemiſphere; they have made it out of the Engonaſin, or Hercules, dividing it into three figures. Others, more moderate in the ſame ſtrain, have ſuffered the figure to remain as it was, and only in the place of Hercules, have put the name of Sampſon. This is very pardonable, the other intolerable; it is making confuſion in the ſcience to no purpoſe, and rendering uſeleſs all the obſervations of the antients.

MAGIERRA. A name by which we find ſome, who are fond of long words and uncommon phraſes, calling the Via Lactea, or Milky Way. It is a barbarous term, and ſeems formed out of a much earlier name Almegires, by which we find it called by ſome, who have affected to write of aſtronomy, in Arabic terms.

MAGNITUDE. The aſtronomer borrows this term from the geometrician, to expreſs that ſpecies, or kind of quantity, which men conceive as extended and diviſible, or as capable of being extended, or of being divided into parts. Under this term he underſtands three different kinds of extended ſubſtance,

ſtance, or of extenſion, or, as they are by ſome termed, three ſpecies of magnitude.

That which is conſidered as extended only in length, without either thickneſs or breadth, he expreſſes by the term *line*, as when he is to meaſure the diſtance between any two of the heavenly bodies, he does it by conceiving a line drawn from the one to the other. In this he has no concern with breadth or thickneſs, but conſiders its length only; this is only ideal, ſince we cannot perceive by our ſenſes any magnitude, or extenſion of this kind, which has not alſo breadth; but it is eaſy to conceive it in the mind's eye, and when we uſe it as meaſure, we ſee it in no other light at all, nor connect any idea of other extent of body with it, either in breadth or thickneſs.

When we conſider magnitude in a farther degree of extent, and look on it as containing both length and breadth, we deſcribe it by the term *ſurface* or *ſuperficies*. This is the term uſed when we would compute the quantity of ſpace between one body, and ſeveral others not lying in a line one with another; when we ſpeak of a ſquare, or a circle, we uſually underſtand them as ſurfaces only of ſuch length and ſuch breadth, without any regard to that thickneſs which, on farther conſideration, may be attributed to them. They may be uſed to deſcribe to us things which have alſo any degree of thickneſs, but they are not leſs ſquares and circles when we connect no ſuch ideas to them. They are perfectly uſed to repreſent ſurface, or admeaſurement of ſurface, nor is any figure or form neceſſary to the diſtinction of what we term ſurface. We ſpeak of any part of the heavens as ſo much in quantity or meaſure, and we mean as ſo much ſurface, for we ſpeak of it only as ſuch a part of ſpace, extended in length and breadth to ſuch or ſuch dimenſions, but we do not at all concern ourſelves about its depth, or enquire how far it runs backward.

Magnitude, regarded in its three ſpecies of extent, conſidered as extended in length, in breadth, and in thickneſs, is the third ſpecies of quantity in matter, and is expreſſed by the term *ſolid*. This with the line or lines which mark the verge of the quantity, and the extent which takes in all between the ſeveral parts of that line or lines, and which makes what we call ſurface or ſuperficies, connects depth or thickneſs. To make this plain by a familiar example, I may meaſure the length of a field only, and this is done by a line: if I take in its breadth and dimenſions the ſeveral ways, this gives the quantity the denomination of a ſurface, and this I may do without conſidering any thing farther; but if I dig for clay or gravel, and firſt examine the depth to which that clay goes, I can meaſure alſo the thickneſs to that depth, and then I conſider it as a ſolid. This will be farther explained under the ſeveral terms, *line*, *ſurface*, and *ſolid*.

Magnitude, *apparent*. The apparent magnitude of a ſtrait line is the angle formed by two ſtrait lines, drawn from the extreme points of that line, and meeting at a certain point in the eye. If we ſuppoſe a circular plane placed before the eye directly, and intended as an object of viſion, we are to imagine ſtrait lines to be drawn from every part of its ſurface through the pupil of the eye; theſe lines will croſs and form two ſimilar cones. The one of theſe has its baſe upon the retina; the other, which is called the optical or viſual cone, has the object for its baſe; the common vertex of theſe two cones, for they are oppoſed point to point, is near the centre of the cryſtalline humour of the eye.

 The

The viſual cone is formed by ſtrait lines drawn from every part of the object to a point in the eye. It is obvious now, that if inſtead of a circle the object were a triangle, a ſquare, or a polygon, the lines drawn from it would have formed a viſual pyramid, inſtead of a cone; but a circle is the more ſimple figure, and therefore it ſerves much the beſt for the explaining this article of apparent magnitude by an inſtance. The apparent magnitude of a circle, is the apparnet magnitude of its diameter. The apparent magnitude of any given circle therefore is proportioned to the diſtance from which it is ſeen, and is the angle formed by two lines carried from the extreme parts of it to the eye, and we ſay its appearent diameter is ſo many degrees, minutes, or ſeconds as that angle contains.

MAGNITUDE, *apparent of the Sun.* When we have obſerved the apparent magnitude of the ſun during the courſe of a whole year, we ſhall have perceived that this varies at different times, and that conſiderably, or, at leaſt, that it ſeems thus to vary: this happens according to the ſun's changing place in the ecliptic. We know, according to the rules of optics, and from continual experience, that any object appears larger as it is brought nearer to us, and ſmaller as it is placed more remote, and from this we ſhall be able to determine, that as the ſun is doubtleſs a fixed body, and, in reality, always of the ſame ſize, it muſt change place with regard to the earth, and muſt at times be nearer to us, and at times farther off. We ſhall be curious to determine what theſe changes of diſtance are, as well as what are the apparent variations in the ſun's diameter; this is eaſily done.

We are to prepare a quadrant with its teleſcope, and to obſerve the height of the upper edge of the ſun's diſk, and that of its lower, as it paſſes through the meridian; it may be moſt conveniently done in this ſituation of the ſun, becauſe if attempted when that luminary is at any other height above the horizon, its continual apparent motion would interrupt the obſervation; but when it is at the meridian, it is ſtill for the ſpace of a minute or two, which is as much as is neceſſary for making the obſervation. We are to correct both theſe heights by the rules of refraction and parallax, ſo as to have the true and exact height of the upper and lower edge of the diſk, and the difference between theſe gives the true diameter of the ſun's diſk. Nothing can be ſo familiar as this obſervation, yet it ſerves many purpoſes; it gives with a ſufficient exactneſs the apparent diameter of the ſun's diſk, and, in conſequence, the reſpect which it bears to the ſeveral diſtances of that luminary from the earth.

This may be done alſo by obſerving, with a well-regulated pendulum, the time which the diameter of the ſun takes to paſs over the meridian, or by an horary circle. It may alſo be done by two parallel threads placed upon a micrometer, and adapted to a teleſcope with which the ſun is viewed; but the firſt method is, of all others, the moſt ſimple and familiar, according to the moſt accurate obſervations taken by all thoſe ways ſucceſſively, and compared one with another; for this is the very way to arrive at the true preciſion; the greateſt diameter of the ſun is thirty-two minutes, thirty-ſeven ſeconds, and twenty-four thirds; and its leaſt diameter is thirty-one minutes, thirty-two ſeconds, and forty-nine thirds.

When we thus know the ſum of the ſun's greateſt apparent diameter and of its leaſt, we have the reſpect of its greateſt and leaſt diſtance from the earth, which is in an inverted ratio to its apparent diameter. As the half of theſe diameters, which is thirty-two minutes

and

and five feconds, is to the greateft diameter, which is thirty-two minutes thirty-feven feconds and an half, fo is one hundred thoufand to one hundred and one thoufand fix hundred and eighty-eight, which is the meafure of the greateft diftance of the fun from the earth; and, taking this from two hundred thoufand, we fhall have the leaft diftance of the fun, which is ninety-eight thoufand three hundred and twelve. The difference between this and the greateft diftance, is three thoufand three hundred and feventy-fix, the half of which being one thoufand fix hundred and eighty-eight, is the meafure of the greateft extremity of the fun's orbit, which is one of the principal of the elements in the theory of this luminary.

MAHI. A name by which fome, who are fond of uncommon words, have called the conftellation Pifces; it is the Perfian name of that conftellation.

MAJORITY, *in Ratio's*. When in two quantities, which have a ratio to each other, the firft, or antecedent, is greater than the fecond, or confequent, the ratio is called a ratio of majority. *See* RATIO.

MALAPH. A name given by fome to a large ftar in the conftellation Cancer. The aftrologers, and fome aftronomers, preferve the appellation; it is no other than the ftar called Præfepe. The word Malaph is the Arabic name, and it fignifies, in that language, a manger.

MALPHELEARTI. A name by which fome, who love uncommon words, have called the conftellation Corona Borealis, or the Northern Crown. It is the Chaldee name of that conftellation.

MANGER. A name given by Schiller to the conftellation of the northern hemifphere called by others Lyra: indeed he has altered the form of the conftellation, and placed the figure of a manger there, under which form he has, as well as he could, ranged the ftars that belong to the Old Harp. He calls this the manger in which our Saviour was laid: but this anfwers no purpofe in the world, and it tends to make great confufion in the fcience.

•MANIS. A conftellation offered to the aftronomical world, and compofed of a feries of very confpicuous unformed ftars near the conftellation Cepheus.

The creature, under the out-lines of whofe figure thefe are arranged in this new-made conftellation, is one of the moft fingular in the world. It is preferved in fome of the moft curious mufæums, and has been mentioned by fome of the late writers under the name of the fcaly lizard, but it is not at all of the lizard kind, although it, in fome degree, refemble them in figure. The antients were unacquainted with it, and but few writers, who have fpoken of it, have done this with any degree of accuracy. It will be found defcribed and figured from the real animal in the hiftory of animals lately publifhed by the author of this work.

The creature is reprefented in this conftellation in its ufual pofition of fquatting down upon the ground with its legs fpread out, its tail a little bent, and its long tongue extended. It is in this manner that in the woods it watches for its prey; it is of the colour of withered leaves, and its fcales fomewhat of their fhape, fo that it is unobferved, and its tongue is thruft out that flies and ants may fix upon it, and it feeds on thefe by drawing it in again.

The conftellation is of confiderable extent in the heavens, and comprehends a great many ftars; fome of thefe are very confiderable, and were

were very ill counted before under the name of this, or that conſtellation. It is placed between Caſſiopeia, Cepheus, the Swan, and the Lizard. There is a great extent of the heavens left vacant between theſe, and all the conſiderable ſtars in that ſpace are comprehended in this conſtellation. Its head is at a ſmall diſtance from the right arm of Caſſiopeia, and its tongue is extended toward the palm-branch, which he holds in her left. The body of the creature runs between the ſceptre in the hand of Cepheus and the Lizard, and the tail is continued down between the head of Cepheus and the head of the Lizard, and by the tail of Cygnus.

The conſpicuous ſtars in the conſtellation Manis are twenty-one in number, and ſome of them are of very conſiderable magnitudes; they follow one another in a crooked ſeries, and are very happily comprehended within and upon the out-lines of this figure. There are two on the head, a conſiderable one at the tip of the noſe, and another much larger at the eye; and there is a third alſo, a conſpicuous and beautiful ſtar, at the extremity of the tongue. At each of the fore feet there is alſo one ſtar, and on the lower part of the back there runs a ſeries of five. Below theſe there is one larger and more conſpicuous at the origin of the hinder leg on the right ſide; and at the foot of the hinder left leg there is another very conſiderable one; this ſtands very near the head of the Lizard. At the beginning of the tail there is a ſmall ſtar on the left ſide, and a little lower, on the ſame ſide, there is another at a conſiderable diſtance; below this there ſtand two more almoſt oppoſite to one another, and placed one on each ſide of that part of the tail. Theſe are oppoſite to the right hand of Cepheus. At ſome diſtance below theſe is a ſingle and very conſpicuous ſtar, this is on the right ſide of the tail toward the end, and it is very near the little ſtar at the extremity of the tail of Cygnus. The remaining ſtars of the Manis are only four, one of them ſtands at ſome diſtance below, this is in the middle of the tail, and beyond this there are two near together alſo in the middle, and, finally, one at the extremity of the tail, not an inconſiderable one, though ſmaller than many of the others.

This and twelve others are the conſtellations, added to thoſe already formed, in this work. There appeared a deficiency of ſome figure in thoſe places where they are ſituated, and theſe figures very happily fill them. If they are accepted by thoſe who profeſs aſtronomy, I ſhall be glad to have added ſomething, be it ever ſo little, to the ſcience; if they are neglected, there is only a little trouble loſt. They have taken up but about as many pages in the deſcription, and the ſtars, of which they are compoſed, muſt have ſtood in the plates where they are given, whether or not they had been connected together by the faint out-line under which they are diſpoſed.

MARA, OR AL MARA. A name by which ſome have called the conſtellation Andromeda; it is one of the Arabian names of that conſtellation, and ſignifies chained.

MARIGH. A name by which ſome, who are fond of uncommon words, call the planet Mars; it is the Arabic name Marigh, and, in the proper ſenſe of the word, ſignifies bloody. A name probably given on account of the ruddy look of this planet.

MARGIMAB. A name by which ſome, who love hard words, call Mercury.

* MARS. The leaſt of all the planets except Mercury, and the moſt diſtant from the ſun except

except Saturn and Jupiter. His place is next above that of the earth in the ſyſtem of the univerſe, his courſe lying between the orbit of the earth and that of Jupiter, but very diſtant from both. Mars is eaſily diſtinguiſhed in the heavens from all the other ſtars, his appearance is, of thoſe of any conſiderable ſize, the leaſt bright or elegant. He is diſtinguiſhed from the fixed ſtars by not having that twinkling which they have, and from the planets by the want of their placid brightneſs and their clear light. Mars appears of a duſky reddiſh hue, and has leſs luſtre than any ſtar in the ſkies. Saturn's light is feeble and dead, compared to that of Jupiter; and Jupiter, at his times of being brighteſt, is vaſtly inferior to Venus; but Mars is below Saturn in this reſpect many degrees, his light is not at all more bright than that of Saturn, and it wants the agreeable whiteneſs. The diffuſion of a reddiſh hue over this planet is ſo very ſingular, that the eye cannot eſcape obſerving it, although it deadens the light that would otherwiſe be ſent to the earth from ſo near a planet.

While we ſpeak of Mars in this light, we are yet to conſider him as a body conſiderably large and extenſive, though not ſo in compariſon of the generality of the other planets. Mars, which appears ſo inconſiderable to us in the heavens, is a globe of more than half the bigneſs of this earth; his diameter is four thouſand eight hundred miles. His diſtance from the ſun is an hundred and twenty-five millions of miles, and his revolution round the ſun is performed in a little leſs than ſix hundred and eighty-ſeven days.

The period of a planet's revolution round the ſun is its year; that of our earth is performed in three hundred and ſixty-five days, and conſequently that is the length of our year, conſequently the year of Mars is nearly equal to two of ours. According to the diſtinction into ſuperior and inferior planets, as they are nearer to, or farther remote from the ſun than our earth, Mars is one of the ſuperior planets, but the loweſt of them.

Mars, like the other two ſuperior planets, when he is in oppoſition to the ſun, is nearer to the earth than when he is in conjunction with it; and this has a very viſible effect in the appearance of the planet. It is for this reaſon that we ſee him, at ſome times, ſmall and very duſky, and, at others, ſo large and luminous, that it would be likely an uninſtructed eye ſhould take him for another ſtar. He ſtill however retains his characteriſtical ruddineſs, and, at beſt, is faint, at the worſt, in his ſmalleſt appearance, the light alſo is ſo troubled, and the colour ſo duſky, that few regard him at all. The difference in his apparent diameter is fully proportioned to the difference of light. When he is neareſt to the earth it is about thirty ſeconds, and, on the other hand, when his diſtance is equal to the mean of the earth and the ſun, he appears but of eleven ſeconds in diameter. How vaſt a diſproportion!

The Moon, Venus, and Mercury, as they are between the earth and the ſun, have, at times, as ſeen from the earth, the form of a creſcent in different degrees; but the ſuperior planets have nothing of this. Mars, though the loweſt, being one of them, can never be found between the earth and the ſun; and, conſequently, although his light is in very different degrees, according to his diſtance from us, yet he always preſerves nearly the ſame form, and ſhews us a round, or nearly round face enlightened. This planet however is not wholly without changes of appearance in its different ſituations. Theſe are not to be ſuppoſed viſible by the naked eye, but by the aſſiſtance of teleſcopes we ſee that the diſk of this planet aſſumes an oval figure from the time of its conjunction with the ſun to its firſt quadrature:

quadrature: at that time it appears much as the moon in her decreafe about three days after the full. From the time of its firft quadrature to that of its oppofition, its disk entirely fills itfelf up, and it appears round; and from the oppofition to the fecond quadrature, it is again in decreafe as in the firft; and finally, from its fecond quadrature to its conjunction again, it takes again its round form.

Thefe are the changes of figure which telefcopes difcover to us in Mars. They are not fo confiderable as thofe of the inferior planets, or of our attendant planet the moon, but ftill they are obfervable. Thefe, however, are not all the ufes that glaffes have difcovered to us with regard to this planet. We fee his furface enlightened in an irregular manner; and his whole disk covered with fpots in the fame manner of that of the moon. In this Mars differs greatly from Saturn and Jupiter: in viewing Saturn we are entertained with the ring and the fatellites, but his furface appears quite plain and equal. Not that we have reafon to fuppofe it is abfolutely even, any more than that of the other planets, but his great diftance renders the inequalities not vifible. There have been fome who have defcribed belts on Saturn, but they are only appearances of belts, they are very far from his furface, and are truly clouds. On the furface of Jupiter, which is very remote, though greatly lefs remote than Saturn, we fee abfolute belts, or tranfverfe broad bands, and fometimes fpots: but thefe are uncertain, of no great duration, and they change their figure; on the other hand, in the nearer body of Mars, we fee abfolute fixed and permanent fpots, and a great number of them; thefe we fee very diftinctly, and they are very large, but they are not feen equally well at all times, but appear with various advantages according to the different ftates of the planet with refpect to its fituation.

From the firft quadrature to the fecond we begin to fee them very plainly, in which time it is near enough to the earth to be feen with great diftinctnefs; at other times, the whole planet is fmaller, and at length reduced to one third of its apparent diameter: in all thefe places the fpots of the planet are more diftant, and grow lefs, are the lefs diftinguifhable, and require the more powerful glaffes: thefe, however, do not make any tolerable amends for the encreafe of diftance. A telefcope of twelve feet will do vaftly more in the time between the firft and fecond quadrature, than one of five and thirty feet afterwards. The fpots, which we diftinguifh in this manner, preferve their figure a great while, when in the fame expofition with regard to the earth: we can, at any time, diftinguifh them one from another by their particular figure; and they might be called by names as well as thofe of the moon; but Mars has been lefs examined or regarded than any of the other planets.

On obferving thefe fpots carefully, we find that they have an apparent motion from eaft to weft, and this brings them back to the place whence they fet out in the fpace of twenty-four hours and forty minutes. It is by thefe fpots that we difcover the revolution of the heavenly bodies round their own axis; as they are adherent to the furface of the planet, they can only turn with it, and confequently its motion is defcribed by theirs. The diftance of Saturn rendering it impoffible to fee any fpots on his furface, takes from us this opportunity of knowing whether he have any fuch revolution. We are ignorant whether he does revolve about his axis or not, though whatfoever others may think from this want of proof, it is moft probable he has, and that we only want the means of evidence. We fee, by the fpots of Mars, that he does revolve round his axis, and that this revolution is

is performed in little more time than that of this earth. The axis of this revolution ſeems a little inclined to the orbit of Mars, and to make a revolution, like that of the axis of the globe of the ſun about the poles of the ecliptic, in ſuch a manner, that the north pole and the ſouth pole are found ſucceſſively on the apparent disk.

Theſe ſpots on the planet Mars were diſcovered at that time when aſtronomy was riſing faſt to its perfection. Caſſini ſaw them in 1666, and ſo good an aſtronomer was not likely to make the diſcovery, and leave it unemployed. He ſaw not only the ſpots, but their motion, and he, from that, firſt determined the revolution of the planet about its axis. From that time the eyes of all the aſtronomers were upon the planet, but they added little to his diſcoveries; he was a maſter of the ſubject; he was indefatigable, and he had the beſt inſtruments that could be procured. His figures of the planet expreſs all that have been ſince deſcribed, but perhaps not all that have been ſince ſeen. At a ſmall diſtance from his largeſt ſpot there is a moſt remarkable conic one, the top of which is decorated with a protuberance of an irregular figure; it is, if not the largeſt, by much the moſt ſingular ſpot on the planet, and one would almoſt be tempted to ſuppoſe it had appeared ſince his time, by his not having deſcribed it. I have ſhewn it to moſt of our aſtronomers through a refracting teleſcope of eighteen feet. There are, on the face of Mars, oppoſite to that which Caſſini has ſo diſtinctly figured, ſome ſpots not unlike, in ſhape and diſpoſition, to thoſe which he has figured there, particularly the ſecond in magnitude, which ſtands at no great diſtance from the centre of the planet in his figures, has one very like it in ſituation on the other hemiſphere. This is indeed more like in ſituation than it is in ſhape, but the ſituation is more regarded. I had the opportunity, ſome time ſince, of ſhewing theſe ſpots in the compaſs of about twelve hours; Mars was very viſible from the top of my houſe in the evening, and continued ſo till morning, we ſaw the very face figured by Caſſini; and, at the diſtance of about twelve hours, the oppoſite face; this was a little before day-light in the morning; the firſt obſervation was, that Mars had made a complete revolution round its axis, for that the ſame ſpots were in the ſame places. On examining particularly why thoſe who ſaw it entertained that opinion, I found that this ſingle ſpot, which is like the ſecond in magnitude of Caſſini, was the object of their attention. I deſired them to look for the larger, and ſo far will fancy go when on a wrong ſcent, that they thought they ſaw ſomething like that alſo, only leſs clear. We had examined the ſpot I have already mentioned; the conic one, with the large head undeſcribed by Caſſini, on the evening obſervation; this was not to be found, and from the abſolute want of this it was given up, that we did not now ſee the ſame hemiſphere of the planet.

The miſtake of theſe gentlemen, with me, was not particular to them; there are ſome accounts of about eighty years ſince, which is within a few years of the firſt diſcovery of the ſpots of Mars, publiſhed at Rome, which, from obſervations of thoſe ſpots, and of their return to their place, fix the revolution of Mars, round his own axis, at thirteen hours inſtead of twenty-four hours forty minutes; but it is plain theſe roſe from the miſtake of taking the two hemiſpheres of Mars, that are nearly oppoſite to one another, to be the ſame; nay, the obſervations, although they are not ſo far particulariſed as to aſcertain that they ſeem to have been made from this very ſpot, which, being nearly, but not exactly, oppoſite to the ſimilar ſpot on the other hemiſphere,

will appear on the ſame part of this hemiſphere which occupied that on the other in the ſpace of thirteen hours. We may ſee from this how eaſy miſtakes are in ſuch nice obſervations; and we ought to learn how ſlow men ought to be in departing from the opinions of thoſe who have examined with care; and with how ſcrupulous a caution they ought to examine every circumſtance on ſuch an occaſion. When the time of Mars's revolution, about his own axis, is ſet down at twenty-four hours and forty minutes, we are to obſerve alſo, that this is not given as his conſtant, nor as his mean motion in that revolution. All the planets have ſome variation in this motion, according to the different part of the orbit in which it is made; but as to Mars, the only time in which he can be viewed with ſucceſs, is from his firſt to his ſecond quadrature, and this is to be underſtood as the period of his revolution round his axis at that time, or in that part of his orbit.

I ſhould the more have wondered at the accurate Caſſini's not having obſerved the ſingular ſpot I have mentioned in Mars, if the face of that planet were ſo perfectly conſiſtent with itſelf at all times in this reſpect, as that of ſome other of the planets. Although the ſpots are, in compariſon of thoſe real ſpots and belts of Jupiter, and of the imaginary belts of Saturn, fixed and permanent, yet they are not totally void of changes in their appearance. In Jupiter ſpots appear at certain times, and are quite loſt at others; nay, the ſame part of the planet ſhall, in the courſe of a week, be plain, ſhall have a ſpot in it, that ſpot ſhall divide itſelf into ſeveral others, theſe ſhall alter their figure, and, at length, they ſhall diſappear, and the place appear plain again; nay, belts ſhall vaniſh where they were, and new ones ſhall appear in other places, and this in a few hours; ſo that, in the ſpace of one evening, there ſhall be two, four, and five, or ſix belts. In compariſon of theſe changes, the ſpots of Mars may be called abſolutely fixed, for they are liable to none ſuch; but ſtill though they keep ſeverally not only their exiſtence, but their places, and, in a great degree, their figure, there is ſomething of a change of appearance among them: ſome, that have been very clear, become confuſed, and ſome, that, were the moſt preciſe indeterminate, till, among the leſſer, many, that, at firſt, were very conſpicuous, are almoſt loſt; others of them, in the different ſituations from the various lights during the courſe of a revolution, alter, in ſome degree, with reſpect to their dimenſions. This is a thing that may have miſled ſome of thoſe ſuperficial gazers, who ſuppoſe aſtronomical diſcoveries are to be made in one evening; and this is, doubtleſs, the real foundation of thoſe exceptions which have been made to the repreſentations of the ſpots in Caſſini's figures, by ſome who pretend to great aſtronomical knowledge here. Some variation in appearance there will be, not only in different oppoſitions of the planet, but in different periods of that oppoſition; but they principally regard the leſſer ſpots, and are only apparent in theſe. There are no real changes of figure but may be principally referred to the ſpots, being more or leſs ſharp or determinate at the edges: the larger remain, at all times, in their places, and retain their form, and were there but one of theſe aſcertained, it would be ſufficient to determine the revolution of the planet on its axis, and to fix the time of that revolution.

In the ſeveral obſervations I have made on this planet for the laſt twelve or fourteen years, I have been led to believe, that, whatſoever thoſe belts are, which appear and diſappear in ſo ſtrange a manner upon the ſurface of Jupiter, there is ſomething analogous to them on Mars, not that there appear

to

to be many of them, but certainly there will ſome time be abſolutely diſcovered one. On uſing a refracting teleſcope of thirty-five feet, I have often ſeen the appearance of an oblong duſky band, quite different from the ſpots on this planet, and always in the ſame place, not far from the centre. Many have ſeen this with me, and have mentioned it without my firſt pointing it out to them; it is continued quite round the planet, but is interrupted in many places, and in ſome is ſo faint, as, for a conſiderable ſpace, not to be viſible. After this, it, by degrees, is ſeen again in exactly the ſame direction, but in its beginning very faint and broken, and, by degrees, becoming perfect. In the whole it is of an obſcure hue, ſomewhat darker than the reſt of the ſurface of the planet, and, when it is moſt perfect, is not very determinate at the edges: it is as broad in proportion to the apparent diameter of the planet, as the broadeſt of the belts of Jupiter, that a little to the north of his centre; and although it has a duſkier hue, yet has ſomething of the general appearance of thoſe belts.

This belt, if it may be ſo called, of Mars, is much better ſeen in ſome oppoſitions of the planet than in others, and if the obſervations be occaſionally continued through the courſe of one oppoſition only, it will be found much more conſpicuous at certain times of it than others: ſometimes there appear only detached pieces of it, which form a kind of oblong and broad duſky ſpots; it was in this appearance that I firſt ſaw it, and when any other obſerver diſcovers one of theſe ſpots, I would wiſh him to be exact in his obſervations for ſome ſucceeding days, and he will make out more. The appearance of an oblong ſpot of this kind was one of the firſt things that directed me to employ more attention, than moſt people have done, to this planet. I conſulted the figures of Caſſini, and found no account of it, no trace, nor veſtige of any thing in the place where ſo large and ſo conſpicuous a ſpot appeared; from time to time it grew more faint, till I entirely loſt it. In a ſucceeding oppoſition of the planet with the ſun, which is the only time for theſe obſervations, I watched ſtrictly for it, and at length diſcovered ſome faint trace of it in its former place. From the day of my firſt ſeeing it, it became more diſtinct, and what was ſingular, appeared to return to its place at nine or ten hours after it was loſt. This might have led a haſty obſerver to diſpute Caſſini's ſettled period of the revolution of the planet about its axis, as the inconſiderate Italians had done from the miſtake of one ſpot for another. It was juſt the ſame caſe here, what I had ſeen was not a return of the ſame oblong duſky ſpot, but the appearance of another ſuch at the ſame part of the planet. Many hours continued obſervation, and that repeated for ſeveral evenings, gave me at length a true knowledge of what theſe ſpots were. They appeared unlike the reſt of the ſpots on the planet, and, in all reſpects, they were like the belts, or parts of the belts, of Jupiter. It is the cuſtom every where, (but no where is it ſo much ſo as in England) to ſtand againſt any thing new in obſervation. Thoſe who had heard me ſpeak of a belt in Mars held the opinion in contempt; thoſe who had been with me in the obſervations would hardly believe that what they ſaw was what they ſaw. From time to time I became able to trace the continuation of one of theſe oblong ſpots over ſome little interruption, perhaps perfect, perhaps only partial, to another, and continue the belt. In this manner I have traced it all round the planet; and one year, when it was more favourably ſeen than before, could diſcover it in a continued, and almoſt uninterrupted courſe, over at leaſt one third of the circumference of the planet where it broke off,

ſome irregular ſpots appeared, and by theſe the belt grew viſible again, but faint; it was after this broader, but leſs perſpicuous, for ſome ſpace, and after that recovered its old dimenſions, and continued of the ſame breadth, though, with many partial, and ſome entire interruptions, to the place where the other had ſet out; but toward that joining it became ſo very faint, that it was no wonder it had not been ſeen in the obſervation of the preceding night, ſince nothing but the keeping the eye along it could have diſcovered what ſlight appearance there was of it there.

I have obſerved that Mars has been more neglected than all the planets, but it is pity that it ſhould be ſo. Here is a theme for obſervation, and I hope it will be continued; the obſervation of ſomething of the appearance of part of a belt on Mars is not entirely new, though overlooked. Maraldi, fifty years ago, thought he ſaw ſomething like it, but, not tracing it accurately enough, he ſuppoſed its extent was but about half over the planet, not quite round it, as it certainly does go. As none of the earlier aſtronomers had ſeen it, none of thoſe, who followed Maraldi, much cared to ſee it. They have either treated the opinion as a chimera, or talked of it from opinion more than obſervation. It is pity he did not employ more time about it. That it ſurrounds the whole globe of Mars I am certain; I have traced it quite round, and although the interruptions are very great in ſome years, they are much leſs in others; the fixing on an unfavourable time may have diſheartened many from the enquiry, but if any one, who is qualified for theſe obſervations, will lay down the globe of Mars in two hemiſpheres, and, from time to time, trace upon it the ſeveral oblong ſpots, and what farther he diſcovers in its ſeveral parts for ſome few revolutions, he will find the whole deſcribe, upon the body of the planet, a belt very near complete.

It has been greatly doubted what theſe belts of the planets are; we are very ready to annex ideas to the ſeveral appearances in them, taken from what we ſee upon the earth; but it is not certain, that we have always reaſon. We talk of ſeas and lakes in the moon, and we call the belts of Jupiter, and his duſky ſpots, by the ſame name very familiarly, but this is no proof that we are right. In the moon it is moſt probable there is no water; for it is certain, there are no exhalations, no clouds about her, nor any atmoſphere; what may be the caſe in this reſpect with Jupiter we cannot ſay, his diſtance is too great to give room for the determination. As to Mars we have proof that he has an atmoſphere; his ruddy colour to the naked eye is owing to its vapours, and there are farther evidences of it. He therefore may have ſeas, and although it ſhould ſeem that ſeas ought to look brighter, and not more duſky than land in one of theſe remote globes, yet every other appearance favours both this and the belts of Jupiter, being in reality vaſt collections of a fluid of ſome kind or other. We ſee iſlands formed, and ſwallowed up again by the ſeas of Jupiter; nay, there is all the appearance in the world of their emptying themſelves occaſionally into one another, and their appearance and diſappearance at times may be owing to their dry channels making no figure, whereas they are viſible as ſeas or belts when the water gets into them. Thus much, although it has not been obſerved by any of the aſtronomers in favour of the belts of Jupiter being truly ſeas, may ſerve to promote the opinion that they are ſo; and if they be ſeas in Jupiter, it is the more probable, that this is a ſea in Mars; in this indeed all the appearances concur in favour of ſuch an opinion. The channel is continued, but it is not perfectly regular; in ſome places it is narrow, and exactly circumſcribed,

ſcribed, there it appears of the duſkyeſt colour, for there it is the deepeſt; and allowing the firſt propoſition, which, however odd it appears, all grant, with regard to the moon and Jupiter, that thoſe parts which are water appear on a diſtant globle more dark than thoſe which are land; it follows, that where that water is deepeſt, the colour will be darker: thus then it is right, and as it ſhould be; the ſea of Mars, when narrow, and limited in its expanſe, is deep, and therefore it is duſky; when it ſpreads, and is leſs regularly limited by banks, it is ſhallower, and conſequently the appearance is paler; theſe narrow parts therefore of the channel make the diſtinct portions of the belt, and the broad ones the interruptions; and this is ſo far confirmed, that, according to the ſtricteſt obſervations, whereſoever the belt is broadeſt it is paleſt, and whereſoever narroweſt darkeſt. But theſe are not the only interruptions to which the belt of Mars is liable; and indeed in this alſo it agrees with the belts of Jupiter: there are frequently lucid ſpots of a larger or a ſmaller extent in the middle of the belt; theſe are doubtleſs iſlands in the ſea, and though ſuch ſpecks to our eyes, they may be vaſt tracts of land, the leaſt of them equal perhaps to this famous England. Theſe bright ſpecks, or ſpots, in the belt of Mars, as well as thoſe in the belts of Jupiter, are ſometimes more, ſometimes leſs viſible. The ſmaller appear, and are loſt at times, the larger change their form as well as magnitude; this may be from changes in the water as to depth or quantity: in Mars the changes are leſs obvious, in Jupiter they are frequent and great; this may be owing to the ſtrange communication there is between his ſeveral belts, or ſeas, as they may empty themſelves more or leſs into one another; and in confirmation of this I have never ſeen that ſpot in the great northern belt of Jupiter ſo large or ſo plain as when the other belts have been broadeſt, which is probably from ſome of its waters running into them, and having its own channel emptier.

This is not the only collateral proof of the belt of Mars being an abſolute ſea. The ſhores or lines which circumſcribe it are not ſtrait or regular: in many places ſpots run from its ſides, with a viſible neck of communication, and ſwell into prodigious lakes; and in other parts, inſtead of ſwelling out both ways, it only does ſo on one ſide, making vaſt gulphs, with promontories at their edge: indeed the whole appearance is of a ſea, and the different degree of plainneſs, with which ſeveral parts of it are ſeen at different times, may very probably be the ſame with that of the occaſional appearance and diſappearance of the leſſer belts of Jupiter, the different derivation of water into them. If it can be allowed, and all ſyſtems ſuppoſe it, that the belts of Jupiter are ſeas, it ſeems a very familiar way of accounting for that phœnomenon, which has ſo ſtrangely perplexed them all, the appearance and diſappearance of them, to ſuppoſe, that they all communicate with the great northern belt in that planet, which is the common reſervoir, that when their beds or channels are dry they are not ſeen, being then like the reſt of the ſurface of the planet; but that as ſoon as water is poured into them from that reſervoir, becoming then ſeas, they are then viſible. This may account for the ſuddenneſs of their appearance, and for the very manner of it, ſince they often begin at ſome one point, the place where the water is rolled, thence continue to advance as it runs forward, till they encompaſs the whole globe according to the direction of their channels. If this be the caſe with them, it perfectly explains the difference between the more determined, and the leſs determined parts of this belt of Mars,

Mars, by making them parts of the ſea, which are narrower and deeper, or broader, and more ſhallow, and they ought to appear, as they do, moſt dark coloured, where there is the greater body of the fluid. In the ſeveral parts of Mars's revolution round the ſun, he appears to have a motion ſometimes direct, ſometimes retrograde, and at other times is ſtationary, or ſeems to ſtand abſolutely ſtill in his place; this is common to Mars, with Jupiter and Saturn, and is not to be ſuppoſed any iregularity in their motions, although it appear ſuch. Theſe planets continue their motion in their orbits, always direct, and nearly in the ſame degree of velocity; but we are to conſider, that the earth, from which we view them, is not fixed in its place, but is at the ſame time making a revolution like to theirs, and round the ſame fixed centre the ſun, to which ſhe is nearer than they, and conſequently her orbit leſs, and the time of her revolution ſmaller. It is owing to this motion of the earth that we ſee theſe planets ſometimes appearing to move one way, and ſometimes another, as alſo ſometimes to be fixed in the heavens, or ſtationary, ſo as to mimic the fixed ſtars: but in the retrogradation, Mars, as nearer to us, runs thro' much larger arcs in the heaven, with reſpect to the fixed ſtars, than the others. It is in part to this alſo that he owes his different appearance, which, as has been already obſerved, is ſometimes that of one of the leaſt and meaneſt of the ſtars, ſometimes great and bright. Even in the time of his oppoſitions to the ſun, which is the period, at which he of right ſhould appear the largeſt, he does not always appear to the earth with the ſame degree of luſtre, nor the ſame magnitude. From this we diſtinguiſh plainly, that he is not only more diſtant from the earth in ſome parts of his revolution than in others, but that he is alſo nearer to the earth in ſome, than he comes in others of thoſe revolutions. This alſo is owing to the motion of the earth combined with his motion, and it is at the time when theſe concur the moſt favourably, (and that may be at any time determined by calculation) that he is to be examined with moſt advantage from the earth, with regard to his ſpots, and particularly with regard to that belt which is ſo worthy the attention of aſtronomers.

As little reſpect as we pay to this planet, it was the obſervation of its different appearances that, in the moſt terrible manner, ſhook the Ptolemaic ſyſtem; and it was his appearance that gave Kepler opportunity to improve upon the Copernican. It was to the motions of this planet that we have owned Kepler's new ſyſtem of the orbits of the planets in general, for it was impoſſible to confine it to any one of them alone. We ſee from this, that it is of the utmoſt importance to the aſtronomers to examine with the utmoſt poſſible attention the theory of this planet, although it is the cuſtom ſo much to neglect it. The old opinions of excentrics and epicycles, and of the ſolidity of the heavens, are all overthrown by the obſervation of this ſingle planet. Copernicus had got rid of the grand ſource of all error, the opinion of the earth's being immoveable, and fixed in the centre of the univerſe; this he had eaſily overthrown, and eſtabliſhed evidence enough in its place; but theſe epicycles he could not get rid of. It is not to be ſuppoſed a man of his true philoſophy could heartily concur in the doctrine of ſo vaſt and heavy body as a planet, making a revolution about an imaginary centre; but though his reaſon contradicted this, he was not able to place any thing elſe in their ſtead, and ſo he heaped them one upon another to explain theſe inequalities and irregularities of direction,

tion, ſtation, and retrogation, which we ſaw in the planets during their courſe in their orbits.

Kepler dived to the bottom of all this, and indeed of all that had been propoſed, or had been eſtabliſhed before him; he allowed truth when he found it, he gave no quarter to error, and he was not content with pointing out what it was, but whence it had ariſen. He ſhews, that all this abſurdity and contradiction to the laws of nature was neceſſary in the ſyſtems of thoſe who ſet out with that ſtrange error of aſſerting the heavens to be ſolid.

Tycho Brahe demonſtrated, that the heavens were not ſolid, becauſe they were traverſed by the comets; and having gone thus far in the road of truth, he flew from it by eſtabliſhing the ſtragne doctrine, that the planets in their revolution deſcribed circles, excentric to the earth, ſuch however, that the mean motion was made round about a point, which was placed out of the centre of the circle. Abſurd as ſuch an opinion was, it was received till Kepler ſhewed the impoſſibility of what it advanced: he proved, that it was wholly repugnant to the laws of nature, that an heavenly body ſhould move itſelf unequally round a perfect circle, and yet in ſuch a manner that it ſhould all the time appear to have an equal rapidity round one point, which point was diſtant from the centre of the circle. What a ſtrange kind of direction, ſays he, muſt we underſtand as neceſſary to a planet in performing its revolution, to make it deſcribe a circle round an imaginary point, and that perfectly exact, and with ſuch degrees of ſwiftneſs, that it ſhould appear to deſcribe equal arcs about another centre, which ſhould not be that of the earth.

The abſurdity of the former ſyſtems no ſooner appeared to this accurate and diſtinguiſhing genius, than conſidering that the orbit of the planet Mars had an excentricity much greater than that of Jupiter, or of Saturn, he fixed upon this as the moſt proper for his purpoſe, and from his obſervations on this he eſtabliſhed his whole ſyſtem, according to which it appears, in the moſt abſolute and unqueſtionable manner, that the planets, not this of Mars alone, but all of them, do not deſcribe circular orbits, or perform their revolution about the ſun in circles, but in ellipſes. He gives the ſun as the fixed point in the univerſe, and the principle of all the motions of the heavenly bodies, and he places this in one of the focis of the ellipſis, and drawing rays from this point, or from the ſun to the planets, in different parts of their orbits, the arc, as contained within thoſe rays, ſhall be proportioned to the times, which the planet particulariſed, takes in running over the arcs of the orbit, compriſed between the extremities of thoſe rays. The eſtabliſhment of this hypotheſis we owe to the obſervations of Kepler on the planet Mars, and it has been received by all the aſtronomers ſince, and will be ſo for ever, for it is conformable to all the obſervations that have been made at any time on the motions of the planets.

I ſhould not leave the conſideration of this planet without obſerving, that although the true condition of one belt, which is at all times more or leſs viſible upon his ſurface, has never to this time been thoroughly conſidered, we are not without writers who have talked of ſeveral. From the proof, that what have been ſuppoſed by ſome ſuperficial obſervers to be belts on the body of Saturn, were only clouds at a diſtance from its body; others, as ſuperficial in their reaſonings, as theſe in their obſervation, have taken for granted, that thoſe of Jupiter were not on his body, but were clouds alſo. From hence they have deſcended

to

to Mars, who as he has a perpetual equinox like Jupiter, muſt have alſo a pretty equal degree of heat in the ſame parallels; and ſuppoſing, that as Jupiter has, he muſt have belts, they not been contented with the one that has been ſcarce, yet well ſeen, but have mentioned ſeveral, which they alſo ſay are clouds in his atmoſphere. We ought to applaud, in no common degree, the genius of this enterpriſing turn, who will create phœnomena in order to account for them: and I am ſorry to remember what names are at the head of ſuch an opinion.

Syſtems ſhould be formed from obſervations, not obſervations pretended to eſtabliſh ſyſtems; even when they are real, they may be miſapplied, but theſe will be of no harm; when they are thus deviſed by the fancy, they pervert all reaſon, and impoſe upon mankind in points that ought of all others to be free from miſrepreſentation. Although all the honour of determining the revolution of the planet Mars, by an obſervation of his ſpots, be due to the elder Caſſini, and in that ſenſe he may be called the diſcoverer of them, we meet with writers before, though but a little before, that time, who talk of the face of the planet being varied; and our Dr. Hook mentioned ſpots, and even the motion of ſpots, on this planet in 1665, which was a year before the time of Caſſini's famous obſervations. Hook's obſervations are much more vague and uncertain, and he had leſs frequently repeated them. He goes ſo far as to ſay, that from the motion of theſe ſpots, Mars muſt have a revolution on its axis; it is amazing ſuch a beginning of a diſcovery was not proſecuted as it deſerved; we generally improve upon the firſt hints of the French; here a Frenchman played the Engliſhman upon us. It is not probable, that either of theſe aſtronomers took the hint of theſe ſpots on Mars from the other; aſtronomical knowledge was in great vogue at that time. Every body was examining the planets, and teleſcopes were juſt brought to their perfection: it was natural that ſuch a diſcovery ſhould be made in more than one place at the ſame time. I am ſorry England was not the place where the moſt uſe was made of it.

MARTHA. A name given by ſome fantaſtical people to the middle ſtar of the three that are in the tail of the Great Bear. Thoſe who call it by this name, do not preſerve to the whole conſtellation the name or figure of a bear, nor the older name of a waggon; they call it a Bier, Feretrum, and they make it, in particular, the Bier of Lazarus, Feretrum Lazari. They call it the three ſtars of the tail Filiæ Feretri, and make them Mary Magdalen, and her Maid; that next to the body is the Mary Magdalen.

MARY MAGDALEN. Among Schiller's Chriſtian names of the conſtellations, this is the denomination of that which others call Caſſiopeia. Hartſdorf, who will have a ſcripture name for this conſtellation, goes back to the Old Teſtament for it, and calls her Bathſheba.

MARY, *or the* VIRGIN MARY. A name given by Schiller and the enthuſiaſts his followers, to the moon. They call the ſun, Chriſt; Saturn, Adam; and the like.

MASATHO. A name which ſome, who are fond of hard words, have called the conſtellation Libra; it is the Syriac name of a pair of ſcales, and is a conſtruction of the Greek Zygos.

MASIK. A name by which ſome, who are fond of uncommon words, call the conſtellation Auriga; it is a part of the Arabic name, the whole is Maſick Al Inan, and it ſignifies one holding a bridle. This is a name which they copied after the Hebrews, whoſe name Ha Roah Schehido Ha Reſan, ſignifies a ſhepherd holding a bridle.

MATER MUNDI, *Mother of the World.* A name by which ſome, who affect to uſe ſtrange terms, call the moon; it is a tranſlation of one of the old Greek names of that planet.

MATTHEW, *or* ST. MATTHEW. A name given by ſome enthuſiaſtic writers to one of the ſigns of the zodiac. It was Schiller who firſt deviſed this Chriſtian ſcheme of the heavens. He has placed St. Matthew in the place of Sagittary. Others, who are determined to have ſomething out of the Old Teſtament, will have Iſhmael to be this figure. But there is no face of utility in theſe innovations, and the confuſion they introduce is palpable. *See* SAGITTARY.

MATTHIAS, *or* ST. MATTHIAS. A name given by ſome fantaſtic writers to one of the twelve ſigns of the zodiac. Schiller is at the head of theſe innovators. He has raiſed the twelve Apoſtles into the place of theſe twelve ſigns, and Matthias is that which has been uſed to be called Piſces. This is an intolerable innovation, as it robs us of the advantage of all the old obſervations; Schickard is determined to make the ſigns commemorate ſcripture ſtories, but he does it much more decently. He lets the fiſh be fiſh ſtill, and ſays they are to ſtand for the two fiſhes which are mentioned in the goſpel of St. John.

MATTER SUBTILE. A term uſed by ſome of the aſtronomical writers, who are unwilling to allow the ſun and fixed ſtars to be globes of fire, to explain what it is of which they are compoſed; but it is an explanation that leaves all greatly in the dark. Theſe philoſophers, unwilling to acknowledge material fire, or any glowing materials, ſuch as we can conceive, capable of diffuſing heat to the compoſition of theſe luminaries, ſay, that they are framed of a ſubtile matter, unlike to all things with which our ſenſes are acquainted, as the cauſe of heat, and yet capable of exciting the ſenſations (ſuch are their terms) both of heat and light.

Not to be at the trouble of combating words, which are ſcarce connected with any ideas, we may produce almoſt an abſolute proof that the ſun is, as the old philoſophers aſſerted, and as moſt of the later have believed, a globe of abſolute fire, or of heated matter; by the appearances which we ſee on examining its diſk; and if ſo, the fixed ſtars, as they are in all other reſpects of the nature of the ſun, they may be ſafely concluded not to differ in this. The very nature of their light diſtinguiſhes theſe from the planets; their luſtre and twinkling ſhew them to be bodies luminous in themſelves, not ſhining with borrowed light as thoſe; and there is all that our obſervations can determine, and perhaps that is more than many are aware, in favour of their being all globes of actual and groſs heated matter, ſuch as our ſenſes are acquainted with, or not unlike to it.

When we ſee the ſun's diſk, we ſee in it a variety of matter, the greater part appears to be a fluid ſubſtance, like to iron, or ſome other groſs metal, in a ſtate of fuſion; and, among this, we ſee maſſes and lumps of a firmer matter, in form of darker ſpecks. Theſe are the ſpots in the ſun, and it is natural there ſhould

 be

be ſuch on the plan of its being a body of groſs heated ſubſtance. But ſuppoſing it this ſubtile matter, capable of exciting the ſenſations of light and heat, we need not, nor indeed could, expect to find ſuch diſtinction of parts in it, but it would be naturally quite uniform.

It is probable, as will be obſerved in its place, that the fixed ſtars alſo have their ſpots, although unſeen by us, becauſe of the diſtance of thoſe luminaries; and upon this indeed depend, perhaps, the true explanation of that moſt ſtrange of all the phænomena in the heavens, the appearance, or ſeeming occaſional creation, of new ſtars. Theſe bodies, which experiments and obſervations prove to be quite out of the ſyſtem influenced by our ſun, and to be placed among the fixed ſtars, and which, although they are allowed to be fixed ſtars, appear only at certain times, have amazed the ordinary obſervers of the heavens, and perplexed the moſt judicious; but they will perhaps be accounted for on this principle.

Theſe new ſtars, as they have been called, (of which that in the conſtellation Caſſiopeia, which appeared in 1572, and was larger and brighter than Sirius, or the biggeſt of the fixed ſtars, was the principal) appear at certain times in the heavens, having all the characters that diſtinguiſh the fixed ſtars, and, after a time, are loſt again. Some of them, as it is ſaid, never ſhewing themſelves again; others appearing after a time, and ſome appearing and diſappearing at ſomewhat like regular intervals.

This great one in Caſſiopeia aſtoniſhed all men at the time, and it had a right the more to appear ſingular, as aſtronomy was not then arrived at any great perfection. This was, next to Venus, the largeſt ſtar in the firmament; it was not only larger than all the fixed ſtars, but larger than Jupiter, and of an amazing brightneſs; they ſaid, and they believed, that it appeared all in an inſtant in this its full glory; but it is more probable that it acquired its bigneſs and brightneſs by degrees, only that it was not regarded till at its full ſize. It continued ſixteen months viſible in the heavens, without changing its place at all with regard to the fixed ſtars about it, and at the end of that time diſappeared, having, for a great part of the period, been diminiſhing in bigneſs and brightneſs.

Authors had ſpoken of ſtars of this kind before. Pliny mentions one ſuch appearing in a part of the heavens where there was no ſtar before or after, and obſerved, as he ſays, by Hipparchus, above an hundred years before Chriſt; we are told of another in the time of Adrian one hundred and thirty years after Chriſt. Lintus tells us of a third as large and bright as Venus, ſeen, as he ſays, by Cuſpinianus, near the Eagle. Another we read of as ſeen by Haly and Albumazar at fifteen degrees of Scorpio; another in the year 945, in the time of Albo, ſeen by Leonitius, between the conſtellations Caſſiopeia and Cepheus; and another in the year 1264, nearly in the ſame part of the heavens. All theſe were ſpoken of in the light of miracle, or extranatural appearances, and this of Caſſiopeia, ſeen in 1572, was added to the number. They are all ſaid to have appeared at once in their full luſtre in the place where before there was no ſtar, and to have diminiſhed gradually till they diſappeared, after ſhining many months. None of theſe ever had been heard of in the ſame places, nor were expected to return again, or had been obſerved to do ſo. They might therefore naturally enough be taken for new ſtars, and ſuppoſed created on the inſtant.

As aſtronomy acquired new improvements, and the heavens became more ſtudied than they had been, it was found that theſe new ſtars were ſingular in nothing but their great ſize,

ſize, for that other parts of the heavens are, at many times, (perhaps one part or other at all times) affording them; and theſe leſs conſpicuous ones were ſoon found, after their diſappearing, to appear again in the ſame places. Many of the ſtars, named by the old writers in certain conſtellations, were not to be found, having diſappeared, and they afterwards were ſeen again, having appeared anew. A ſtar, like that in Caſſiopeia, was ſeen in Serpentary in the year 1604, and before this a new one, of a third magnitude, was diſcovered in the neck of the Whale. This was not a ſtar abſolutely unheard of before, but ſome, who had deſcribed the conſtellation, had omitted it, becauſe not viſible at the time they viewed that part of the heavens; and others have ſet it down, at different degrees of magnitude, under the third, according to its appearance at the time of their obſervation. This has been the caſe with ſome other of the fixed ſtars, not mentioned by the earlier writers, and ſeen now, but not all of them, for there are many they certainly never ſaw; and this obſervation alſo excuſes them of the miſrepreſentation laid to their charge, in ſetting down others in particular places, where thoſe who examined afterwards did not ſee them. It is not that the earlier writers pretended to have ſeen ſtars where they did not, but they viewed thoſe parts of the heavens when ſome of theſe ſtars were viſible, which only are viſible at times, and the others examined them when they were not ſo.

This new one, in the neck of the Whale, began to ſet the phœnomenon leſs in the light of a miracle. Though not ſo conſpicuous as the earlier noticed ones, it was more ſtrictly obſerved; Fabrius ſaw it in 1596 of the third magnitude; Bayer in 1603, as a ſtar of the fourth, and afterwards Holwarda in 1637. This laſt author, not having obſerved that it was in Bayer, ſaw that it appeared in a part of the heavens where it had not been ſeen ſome little time before, and publiſhed his accounts of it as quite new; he watched its appearance till he found it appeared and diſappeared at tolerably regular periods, coming to its full brightneſs and magnitude in three hundred and thirty-three days; and it has been obſerved to hold the ſame changes, and ſomething like the ſame period ſince. It is firſt ſeen as the ſmalleſt ſtar that can be imagined viſible. From this ſtate it arrives at its full bigneſs and brightneſs by ſlow degrees, and after it has continued in it about a fortnight, begins to grow leſs, and from this time continues diminiſhing till it is quite loſt. The time of its diſappearing is about four months, and then it is ſeen again, a ſmall ſpeck of light gradually encreaſing as before. This change of appearance is obſerved tolerably regularly, only that it is ſometimes miſſed for ſeveral years together. From 1672 to 1676 Hevelius declares it was inviſible; when it does appear, it is at the greateſt bigneſs, in ſome years only equal to a ſtar of the fifth magnitude; and at other times it exceeds one of the ſecond, but the bigneſs of the third is its uſual ſtandard. Its times of continuing viſible alſo vary at different periods, and in ſome of its appearances it has been found to advance from its firſt ſtage quickly to its bigneſs, and to diminiſh ſlowly; in others, to advance ſlowly and diminiſh quickly.

There have been many of theſe ſtars of this kind ſince diſcovered, ſtars which are at certain times inviſible, at others ſmall, and at others larger, and this with a tolerable regularity; there are three ſuch in the Swan, one in the tail of the Serpent, and ſeveral others in the other conſtellations, which gradually encreaſe and decreaſe in bigneſs, and at times quite diſappear. All theſe are ſmall at firſt, and

grow gradually larger till they become conſpicuous, and then diminiſh again.

This being known, the wonder as to that in Caſſiopeia appears leſs, but ſtill there is to be ſought ſome cauſe of this appearance and diſappearance of ſtars, which thus keep their places in the heavens, although they have ſo many variations. The great one of Caſſiopeia has been ſuppoſed a comet by ſome, and by others a planet on fire; but its keeping in its place alone were enough to refute thoſe opinions. Riccioli advanced an opinion, as to this and the other ſtars, which thus change their appearance, having one of their hemiſpheres luminous and the other dark; he ſuppoſes the dark hemiſphere naturally turned to us, but that the Almighty, when he would uſe theſe his works as portents or ſigns, turns about the bright hemiſphere towards the earth. Banilland adopts the opinion of the two different hemiſpheres, but he does not make the change a matter of miracle, but ſuppoſes that they revolve about their axis in long periods, and ſo occaſionally turn the bright and the dark ſide to us; and this agrees better, not only with reaſon and the courſe of nature, but with the appearances, ſince this explains the gradual encreaſe of the light and bigneſs from the ſmalleſt to the largeſt ſize, and its gradual decreaſe again. They are not, however, regular enough in their motions perfectly to warrant this, and poſſibly there may be another way of ſolving the difficulty. This, if it be allowed, will prove, that the fixed ſtars are not, any more than the ſun, compoſed of ſubtile matter, but of abſolute heated ſubſtance.

As we have reaſon to ſuppoſe them like the ſun in many other reſpects, let us alſo ſuppoſe them like to that luminary in their compoſition; that is, let us conceive them to be vaſt maſſes of a fluid fiery matter, with lumps of hard and duſky ſubſtances among it. We ſee theſe thrown up at ſome times to the ſurface on the ſun's diſk, and there appearing in form of obſcure ſpots, and at other times buried, or ſunk under the fluid matter and inviſible. When the whole fluid ſurface is clear of them, the ſun is moſt bright; when they are very numerous, as they are at ſome times, they muſt, in ſome degree, impair his light and luſtre, and there have been years in which they actually have done ſo.

Now we may ſuppoſe the fixed ſtars liable, in ſome manner, to this change of appearance, from the ſpots being more frequent, not only at ſome times than at others, but more frequent in ſome than in other of the ſtars. As we ſee theſe opake maſſes, which cauſe the ſpots in the ſun, at times, thrown up to the ſurface, and, at times, buried in the fluid matter; ſo it may be in the ſtars; and it may be that theſe in particular, which appear and diſappear at times, and which, during the period of their being viſible, are continually changing appearance, becoming gradually larger, and gradually ſmaller again, have more of this opake and hard matter than the others. We may account for all their changes in this caſe by conceiving that, as in the ſun, ſo in theſe ſtars, there is a continual motion, by degrees, throwing theſe ſolid maſſes up to the ſurface, and, by degrees, taking them down, or ſwallowing them up again. Let us ſuppoſe the whole ſurface covered in a certain degree with them, inſomuch as not to be viſible to us: this may, perhaps, be the general ſtate of that great ſtar in Caſſiopeia, which, doubtleſs, at this hour, holds its place where it was, although we do not ſee it, and it may occaſionally be ſo with the others; the fluid, at ſome certain time, begins to ſwell about and between theſe maſſes, and to plunge down, or overwhelm ſome of them; at length ſo many are ſunk, that enough of the bright fluid ſurface appears to

transmit its light to us. We see it then as a star of the sixth magnitude. The fluid matter continues its motions, and, by degrees, overwhelms and draws in more and more, till at length the whole quantity, or a very considerable part of it, be buried under the surface. The appearance this would have to us is evidently that of the stars becoming brighter and larger to its full size, or to a certain degree of it. This will account even for all the variations. Let us imagine the star properly, and, when fully seen, of the second magnitude; if all the spots be obliterated, that is, all the masses of opake matter be swallowed up in the fluid, the star will appear of its full size, and be of the second degree; but if a only a certain part, it will appear only one of the third, or as one of the fourth magnitude, as is the case, at times, with that in the neck of the Whale. From the time of this full appearance, we may conceive the spots, or lumps of matter, rising to the surface again by degrees, and consequently the light and bigness of the star diminishing by degrees, till quite extinguished, with regard to us, as in the period of the first observation.

This system not only accounts for the difference of the several states of the greatest light and bigness, but for all the variety of the advances to it. If it were done by a revolution about the axis, the advances and the decrease ought always to be regular; on the contrary, they are not so; this system accounts for their irregularity, and indeed nothing uniform can be expected in the progress of the star, to or from its greatest lustre, if it be owing merely to the throwing up, and the swallowing again of these spots, or masses of solid and dark matter.

We are not to imagine, that, in order to the stars disappearing with respect to us, from this principle, every part of its surface should be totally covered with these spots. When we consider the immense distance of these luminaries, we shall find, that the satellites of the planets, Jupiter and Saturn, turn toward us, more or less of their more spotted hemisphere, the consequence is not, as might at first sight be imagined, that they appear more dusky, but they become, with respect to us, smaller, and one of Saturn, the fifth, when a great deal of the most spotted surface is toward us, absolutely disappears. Thus, in these stars, when a great quantity of the hard and opake matter is thrown up to the surface in spots, although that surface be not entirely, or indeed nearly all covered with it, yet the star may disappear at this distance; and as fewer of those spots are on the surface, that is, as more of the fluid matter appears, they may be more visible.

This seems, according to the known laws of nature, to solve all the perplexities attending these changes in certain of the fixed stars; nor does it reject the opinion of a revolution of those stars round their axis, although it does not concern that motion in the production of the appearances. It is probable all the heavenly bodies have that motion; but as, in this case, all parts of the surface of the star may be easily supposed spotted in a somewhat equal degree, or free of spots in the same proportion; it is all one what hemisphere of them is turned to us. All this is, however, barely proposed to the astronomical world; it is no more than conjecture, and every one, after he has considered it, is to determine as he pleases.

MAXIMUS SEMPER APPARENTIUM. A term by which we find many of the antient astronomers mentioning what they otherwise called the arctic circle. These were the two names they gave to the largest parallel that was seen entire above the horizon in any

place

place in north latitude. Within this were comprehended all those ſtars which never ſet in that place, but were carried about in their whole revolution all the way above the horizon in circles parallel to the equator, and conſequently always in ſight.

MAXIMUS SEMPER OCCULTORUM. A term which we frequently meet with in the old aſtronomers, and which they uſe to expreſs the circle, for ſo they underſtand the term Ceralius, which contains all thoſe ſtars that never riſe in any place of north latitude: they call the ſame circle the antarctic circle, and underſtand by it the largeſt parallel that is entirely hid below the horizon of any place in north latitude. All the ſtars that are contained in this circle are carried round in circles, parallel to the equator, no part of which circles, or parallels, coming above the horizon, the ſtars that are comprehended in their compaſs can never riſe in that place.

MAZAL TOB. A name by which ſome of the writers, among the aſtronomers of the middle ages, have called the planet Jupiter; the ſenſe of the words is the *ſtar of good fortune*. Judicial aſtrology at that time diſgraced the ſtudy of aſtronomy by the alliance it claimed with it, and this was probably one of the terms uſed to denote an imaginary influence of the planet. The enthuſiaſts, who adhered to the principles of that art, called Saturn the cold and malignant planet, and ſuppoſed heat, and rage, and fury, the influence of Mars. They placed Jupiter between their extremes, and ſuppoſed him benign and gentle, and ſo a friend to human kind.

MAZEUS. A name by which ſome, who are fond of uſing uncommon words, call the planet Jupiter. Heſychius ſays, it is a name of Jupiter in the Phrygian language.

MAZZAROTH. A term uſed in the Chaldæan aſtronomy, and preſerved to us in the books of the Old Teſtament; it expreſſed ſomething which has no name in the aſtronomy of any other people, and which may be rendered the circle of the moon. They remarked the paſſage of the moon by the ſeveral fixed ſtars in the period of her revolution round the earth, and this conſiſting of twenty-eight days, they divided that circle into twenty-eight parts, allotting one to every day; theſe they marked in the heavens by certain ſtars, or by certain ſpaces; for in ſome of theſe parts there were no other ſtars viſible to the naked eye, and there were at this time no aſſiſtances to it: and theſe parts of the circle, whether characteriſed by certain ſtars, or not, they called, by a term expreſſing, the manſions of the moon. Theſe followed one another in ſucceſſion in their riſings and ſettings, and to this alludes the phraſe in the book of Job, which mentions the bringing forth Mazzaroth in his ſeaſon, that is, the cauſing every manſion, of which Mazzaroth conſiſted, to appear in its regular proceſſion. The Hebrews had a frequent uſe of that figure, which mentions a whole by ſome of its parts; and the plain ſenſe of this is, Canſt thou direct the courſe of the heavens, and makes every conſtellation follow in its proper place and order? The Latin tranſlation of the bible has in ſome places put, by a ſtrange miſtake, the name of the planet Venus, Lucifer in the place of this word Mazzaroth; but the Septuagint have retained the original word, as it would have been always beſt to have done in caſes where they did not underſtand the term; where it alluded to a cuſtom at that time loſt, or when it referred to a ſcience the tranſlators were not augmented with. Inſtead of this we find them in many places making ſtrange havock among the conſtellations. Though few of them are

men-

mentioned, all that are mentioned are misrepresented by the translators. Chimah, which is the name of Orion, is translated the Pleiades; Chesil, which is the Great Bear, is translated Orion; and Aish, which is the Pleiades, is rendered Arcturus. This Aish is mentioned in the same sentence in the book of Job, in which Mazzaroth is named, as being brought forth in its season, and it is mentioned in a sense, in some degree, similiar. Canst thou bring forth Mazzaroth in its season, has been already explained to mean, canst thou lead up into the horizon the several stars in their order, through whose places the moon passes in her monthly revolution round the earth? And the succeeding expression, or guide the Pleiades and its children, means direct the course of the stars through the greater period, or that of the year. In the antient account of time the Pleiades, or the constellation Taurus, in which the Pleiades are situated, was that which began the year, and therefore all the rest of the constellations, as they followed it, and in some sort depended on it, were very naturally, in the language of the east, called its sons. By this explication of the words used as denominations of the peculiar things referred to in this passage of the Old Testament, we understand the passage, and we find it to be very noble and figurative, correspondent in its several parts, and complete in the whole; whereas, on the common footing, it remains absurd or unintelligible. The two constellations mentioned before this circle of the moon, and constellation of the new year, it has been observed already, are, when properly translated, Orion and the Bear; the one a guide to the husbandman in the tillage of his ground, pointing out by its rising the period of certain important operations; the other the great direction of travellers and voyagers; for in old times they had as much respect to the northern stars, in traversing the desarts of Arabia, as in going by sea. Thus then we shall find the sense of the passage very magnificent and glorious. It is the Almighty who is represented speaking, and in enumerating to man his power and goodness, he says, Canst thou prevent the good season which is presaged by Orion? or canst thou loose the bands of the Bear, and make it forsake that fixed station in which it is so useful to mankind? Canst thou call forth the stars through the places of which the moon directs her course, or bid the whole army of the constellations follow one another throughout the period of the year? This was a language natural for the inspired writer to put in the mouth of the Almighty, and this is exactly expressed by the terms in the passage, when those terms are properly understood; but as they are commonly rendered, it is difficult to say, that they have a title to any meaning, at least to any appropriated meaning. Mr. Costard, who has written with great accuracy and judgment on this subject, imagines the terms, loose the bands of Chesil, to be applicable to the old figure under which that constellation was represented by the Greek, and their masters, the Egyptians, which was not that of a bear, but a waggon, and supposes they refer to the harness with which the three stars, which are in the tail of the Bear, and which are the horses in the other figure, are fixed to the machine; but it seems much more great, and more proper to the occasion, on which this constellation is mentioned in the text, to suppose the allusion was to the fixed nature of those stars, whose keeping always in the same place is their great use to mankind, and whose being so fixed might be very well expressed in the figurative language of the east, by a phrase that mentioned them as girded or fastened to the pole.

MECHA-

MECHARES. A name by which thoſe, who are fond of unuſual words, call the planet Mars; it is a Hebrew name of that planet. The proper ſenſe of the word is deſtroying. The Jews had a notion of this planet being of a miſchievous, as they had of Jupiter being of a friendly and benign quality, and the opinion has been continued.

MEDIUM. When we ſpeak of light, any body that is tranſparent, or through which the rays of light can paſs, is called a medium. Thus the air, water, oil, and the like, are mediums. *See* LIGHT.

If the medium, through which the rays of light paſs, be, in all its parts, of the ſame denſity, then the rays of light will paſs along in ſtrait lines. If a ray of light paſs in its courſe out of one medium into another, and the ſecond be of a degree of denſity different from the firſt, as if it paſs out of air into glaſs, or out of glaſs into air, if it falls perpendicularly upon the ſurface of the ſecond medium, it will continue to go on in a ſtrait line, in the ſame direction as through the firſt medium; but if it falls obliquely upon the ſecond medium, it will be bent at the point of incidence, and it will go through the ſecond medium in a different direction: this bending of the rays is what is called refraction. *See* REFRACTION.

MEDICÆAN STARS. The ſatellites of Jupiter, ſo named by Galileo, who firſt diſcovered them, in compliment to the family of Medicis his patron; they were diſcovered in the year 1610; they are four in number, and in ſpeaking of them are diſtinguiſhed by the names of the firſt, ſecond, third, and fourth ſatellite, the firſt being that neareſt to the body of the planet. They have their light from the ſun, in the manner of our moon, and they turn about the planet as ſhe does round this earth, being in effect ſo many moons, given, perhaps, in ſome degree, to compenſate for the diſtance of that planet from the ſource of light. Saturn, as more diſtant, yet has five ſatellites, and beſide theſe has a lucid ring, which is probably no other than a congeries of ſuch ſatellites. *See all this farther explained under the term* SATELLITES, *and under the article* SATURN.

MEDUSÆUS. A name by which ſome, who love uncommon terms, have called the Pegaſus a Great Horſe of the ſkies; it is an old Latin name.

MEGISTO. A name by which ſome of the old writers have called the conſtellation Urſa Major, from the name of an Arcadian nymph, transformed into this conſtellation, whoſe true name, they ſay, was not Calliſto, as uſually ſuppoſed, but Megiſto, and who was not daughter, but niece to Lycaon, and daughter to Ceteus, which Ceteus, and not Hercules, they ſay, is the old conſtellation Engonaſin.

MELICHI. A name by which ſome call a ſtar of the firſt magnitude in the conſtellation Leo; it is the ſame with that commonly named Cor Leonis and Baſilicus.

MELOCH. A name by which thoſe, who are fond of uncommon terms, call the planet Mars; it is one of the Egyptian names, and ſignifies the planet of deſtruction. All nations ſeem to have been agreed in giving a bad character to this planet; they ſuppoſed it the cauſe of all bad things, as Jupiter of all favourable and good ones.

MEMESCHIATH. A name by which ſome, who love hard words, call the con-

ſtella-

ſtellation Auriga; it is one of the Arabic names of this conſtellation, and it expreſſes the figure as the Arabs gave it. The ſenſe of the word is a mule with a bridle, and their religion not permiting them to draw the figure of any thing human, it is thus they expreſſed the form of this conſtellation.

MEMBRA VULCANI. An affected term, by which we find ſome writers, who are fond of uncommon expreſſions, call the fixed ſtars, by way of diſtinction from the planets; they meant by this to expreſs, in the poetical manner of the antient Greeks, that the fixed ſtars were fire, or portions of ſome univerſal fire, for that was one of their doctrines. We meet with the term in ſome of the affected writers of our own country, uſed to expreſs the heavenly bodies in general, including the planets and the moon; but this is uſing the antients unfairly, and is either taking away their diſtinction, or ſetting aſide the propriety and expreſſion of the word. We find in the fragments of Orpheus, indeed, the ſun, moon, ſtars, and planets, all included under the term Hephaiſtaio Mele, the limbs or parts of Vulcan; but we ſhould find it difficult to obtain any ſatisfactory proof of thoſe fragments belonging to the perſon whoſe name they bear; they are more probably the invention of ſome genius of the middle age, and may be very well brought to anſwer the time of this confuſion, in which the diſtinction, eſtabliſhed by the antients in the term, was loſt, and all the heavenly bodies indiſcriminately called by a name, which was deviſed on purpoſe to ſpeak the difference among them. It is much to their credit, that when they thus gave a name that diſtinguiſhed ſuch of the heavenly bodies as were fiery, from ſuch as were not, they took into the number of thoſe that were the ſun, or we ſhall find that luminary always comprehended in the number of the Membra Vulcani, and the moon not.

MENALIPPE. A name by which ſome call the conſtellation Pegaſus,

MEUKAR ALKETUS. A name by which ſome, who love uncommon terms, have called a bright ſtar that is in the anterior part of the head of the conſtellation Cetus; it is one of the Arabic names of ſingle ſtars, and it ſignifies in that language the Whale's Noſe.

MERCAB. A name by which ſome, who are fond of uncommon words, call the conſtellation Argo, or the Ship; it is the Arabic name of that ſign: but there is ſomething ſingular in it, for the word in that language does not expreſs a ſhip, but a chariot. We are not to imagine, however, that they figured it as a chariot, for ſhips were ſo new when this was raiſed up into the heavens, that it is not a wonder if they wanted a name for them. In effect we find, that they were called chariots of the ſea, and flying chariots, by the oldeſt of the Greek writers; and this explains the Currus Volitans, and Arma Thalaſes, which have been names among the Latins and Greeks for this conſtellation. We find indeed, that beſide the name Mercab, it is called in the Arabic Al Seplina, which ſtrictly ſignifies a ſhip.

* MERCURY. The leaſt, and leaſt conſiderable, of any of the planets, and the neareſt to the ſun. Mercury is eaſily diſtinguiſhed from the other ſtars, but he is rarely to be ſeen for any ſpace of time together. The colour of his light is perfectly white like that of Venus, and much brighter, but he is always ſo near the ſun that we hardly ſee him when

it is quite dark, ſo as to judge of him. The fixed ſtars are known from the planets in general by their brightneſs or twinkling, but this is leſs the caſe with reſpect to the inferior planets, for Venus has ſome of this twinkling to the eye, and Mercury has more. If at any time we ſee a bright ſilvery-looking ſtar near the place of the ſun, as juſt before the ſun-riſe in the eaſt, or in the weſt ſoon after ſun-ſet, with a fine clear light, and great luſtre, it is Mercury.

Mercury is vaſtly ſmaller than any of the other planets. Venus, which is the ſmalleſt next to him, is ſeven thouſand nine hundred miles in diameter, but the diameter of Mercury is only two thouſand ſix hundred: if this be inconſiderable with reſpect to Venus, what an attom is it when compared to Jupiter, which is ſeventy-ſeven thouſand miles in diameter? We often ſuppoſe the planets habitable, and indeed it ſhould not ſeem that the Almighty's beneficence, which has not left with us a drop of water unpeopled, would make ſuch vaſt orbs to be of no uſe; but if they are inhabited, it muſt be by creatures very different in their frame from ours. The cold of Jupiter muſt be intenſe to a degree with which we are not acquainted even in theory; what then muſt be that of the yet more remote Saturn? To an inhabitant in that planet, the ſun would be ſeen only as a large ſtar, twice, or little more than twice as big as Venus appears to us; but with Mercury the conſideration is of another kind; he is ſo near the ſun, that the heat upon his ſurface muſt be ſufficient to make water boil; this diſtance is indeed ſtrangely ſmall in compariſon with that of the other planets. The diſtance of the earth, for it is by its diſtance that we moſt naturally meaſure the others, is eighty-two millions of miles; that of Saturn is ſeven hundred and eighty millions of miles, and that of Mercury is only thirty-two millions of miles. The time of the revolution of a planet round the ſun is the meaſure of the year of that planet. The earth performs her courſe in three hundred and ſixty-five days and a quarter, that therefore is the period of our year; Saturn is ten thouſand, ſeven hundred, and fifty-nine days in making his revolution; ſo that his year conſiſts of all that time. Mercury, on the contrary, finiſhes his courſe in eighty-ſeven days, twenty-three hours, and ſixteen minutes, that period therefore is the year of this planet.

The reaſon that we ſee Mercury ſo ſeldom, is, that performing his whole revolution ſo near the ſun, he is almoſt always hidden by the rays of that luminary; and from the ſcarce opprtunities of obſervation, and ſome other cauſes, to be mentioned in their place, we know leſs of Mercury than of moſt of the other planets, though they are ſo vaſtly more remote, both from the ſun and from us. England is an unlucky part of the world alſo for ſeeing Mercury, for he is leſs viſible by much in the northern than in the ſouthern climates; for this reaſon, that the more oblique the ſphere, the leſs this planet appears above the horizon, whether it be before the riſing of the ſun, or after its ſetting.

Mercury ſometimes, however, is at the diſtance of twenty-ſeven or twenty-eight degrees from the ſun, that is, as far from it as the moon is two days before, or two days after her conjunction; in the other revolutions he is diſtant only eighteen degrees; his greateſt digreſſions therefore vary no leſs than nine degrees, which is nearly a third of his greateſt.

The revolution of Mercury about the ſun is like that of all the other planets in an ellipſis, not in a circular orbit, as had been believed until the time of Kepler. The ſun is in one of the focuſes of this ellipſis, and he is there-

therefore ſometimes more, ſometimes leſs diſtant from that luminary: the proportion of his greateſt diſtance from the ſun to his leaſt, it is nearly as two to three; the great axis of this ellipſis is to that of his annual orbit, as thirty-nine to an hundred; ſo that the diſtance of Mercury from the ſun exceeds a little the half of the diſtance of Venus from that luminary.

As Mercury is never to be ſeen unleſs at the time of his greateſt digreſſions from the ſun, he never appears full, or of a round figure, as ſeen through the teleſcopes, but either cut in half, as the moon at her quadratures, and ſo repreſenting an half moon, or a little more convex, or concave in form, approaching to a new moon or creſent. Venus is in a part of her orbit ſeen round, but Mercury never; not but there are ſituations in which he would appear ſo, but in theſe he is not viſible to us at all, and at the beſt times he is not ſo near to the horizon, and ſo obſcured by the vapours of our atmoſphere, that it is not eaſy to diſtinguiſh his figure perfectly, or to meaſure his diameter; we therefore know leſs of him than of any other. Howſoever, we diſtinguiſh thus much, even by theſe imperfect obſervations, that Mercury is not a fixed ſtar, nor has the ſource of his light in himſelf. We ſee that he receives his illumination from the ſun, and that he turns about the ſun in the manner of the other planets.

It is neceſſary, that Mercury, in ſome of his conjunctions, muſt paſs immediately over, or before, the body of the ſun; in this caſe he is ſeen in the ſun, or traverſing his diſk in form of a black ſpot. This ſingular phœnomenon was firſt ſeen by Gaſſendi, about an hundred and twenty-two years ago, and ſince that it has happened, and has been obſerved ſeveral times: the ſame thing may alſo happen to Venus, but, as ſhe is more diſtant from the ſun, more rarely; it has been ſeen, and we ſhall have an opportunity of ſeeing it again in 1761.

Theſe are obſervations very favourable for determining many things with regard to the planet Mercury; but there are difficulties attending the concluſions even from theſe. When the diſk of the ſun has been examined at the time of ſome of theſe tranſits, or paſſages of Mercury over it, the body of that planet has appeared exactly round, and in others of them he has appeared a little oval. We conclude from theſe obſervations, that the figure of Mercury is ſpherical, or nearly ſpherical.

As to the magnitude of the planet taken from theſe obſervations, Gaſſendi, in the firſt of them, was of opinion, that the apparent diameter of Mercury was equal to about one hundredth part of that of the ſun. Galileo made the ſun an hundred and eighteen, or an hundred and nineteen times the diameter of Mercury at the ſame diſtance, which agrees yet better with the obſervation of Hevelius, who judged the ſun's diameter an hundred and twenty times larger when Mercury was yet near to the earth, than in either of their obſervations; he found it in 1736 to be nine ſeconds and fifty thirds, that of the ſun being thirty-two minutes and thirty ſeconds. The diſtance of the earth from Mercury at that time, was to the diſtance of the earth from the ſun, as ſix hundred and eight-five to a thouſand. And from this it follows, that the true diameter of Mercury is ſix ſeconds and forty thirds, which is to that of the ſun nearly as one to three hundred.

In conſidering the theory of Venus, we have recourſe to the obſervations of the antient aſtronomers, made with regard to that planet's greateſt digreſſions; for the orbit of Venus having but a very little excentricity

may be considered as a circle, and we may determine by the means of that planet's digressions, her true place seen from the sun, which must be then about three signs distant from its true place seen from the earth; but this will not do in examining the theory of Mercury, his orbit being sensibly elliptic, and its excentricity exceeding very much, not only that of the orbit of Venus, but indeed that of any other of the planets. For this reason we can place no dependance upon the antient observations with regard to Mercury, for it was from this impossible for any of the astronomers, who have used the circular hypothesis, to explain the theory of the planets, to fix exactly the motions of Mercury. It is only since the time of Kepler, who established the doctrine of elliptic orbits for them, that any thing can be learned from the observations of astronomers, the differences between the calculations of astronomers amounting to no less than seven degrees. For this reason we are to employ, in the settling the theory of this planet, the observations of Mercury made in his conjunction with the sun, in the time when that planet, being near his nodes, passes over, or before, the disk of the sun. These are observations, the opportunities of which do not happen frequently, but they are very favourable for determining the true motions of the planets, and these, although they are but of modern date, yet ought, by their great precision, to atone for all the advantages which, in other cases, we have, from comparing very antient with modern observations.

The first of these known transits of Mercury over the disk of the sun, and which, as already observed, was seen by Gassendi in 1631, was foretold by Kepler some years before, according to his new hypothesis; in this he was fortunate, the appearance was on the day, and at the time mentioned, but he was not so happy with regard to Venus; he foretold, that she should also, in the same year, pass over the sun's disk; but whatsoever attention Gassendi used to observe, this he saw nothing of. The planet Mercury was seen exactly, according to his prediction, on the seventh of November, a little before nine in the morning, in form of a little round black spot on the sun's disk. Although Gassendi was apprised of the phœnomenon, and expected it at the time, he did not at all suppose, that what he saw was what he looked for and expected. He took the little speck to be a new spot which he had not seen the day before, of the nature of the other spots, on the body of the sun, which he had often seen form themselves a-new in this manner. The spot appeared, in this sense, a very singular, and a very considerable one, but still he continued to believe it must be such; for although he expected Mercury there, it was impossible for him to conceive that planet should make so small an appearance upon the disk of the sun. This unlucky mistake made him loose a great part of the observation, but he saw at length, by the motion of the spot, that it was not one of those which belong to the sun's body, and are adherent to his surface; he recollected that, different as the the appearace was from what he expected, it must be Mercury, and he observed it carefully from this time till its going off. The moment when the centre of the planet was on the edge of the sun's disk, was at twenty-eight minutes after ten o'clock, the sun being at that time twenty-one degrees, and forty-four minutes high; and adding three minutes for the parallax, he found the true height of the sun to be twenty-one degrees, forty-two minutes; and supposing the declination to be sixteen degrees, nineteen minutes, the elevation of the pole at Paris forty-eight degrees, fifty-two minutes, he

he fixes the true time of the paſſage of Mercury off from the ſun's diſk, at twenty-eight minutes after ten. Gaſſendi confeſſes, that he did not find, with the ſame exactneſs, the point of the ſun's diſk from which Mercury went off; but he judged it to be about thirty-two or thirty-three degrees diſtant from the vertical between the north and the weſt. The angle of the ecliptic, with the vertical, was at that time fifty-ſix degrees, forty-ſeven minutes, from which, taking thirty-two degrees, thirty minutes, there remain twenty-four degrees, ſeventeen minutes, which meaſure the arc of the diſk of the ſun, between the place of Mercury and the ecliptic, whence the north latitude is found at ſix minutes, twenty ſeconds, of which the diameter of the ſun is fifteen minutes, and twenty-five ſeconds.

Theſe are the obſervations neceſſary to render the tranſits of Mercury and Venus uſeful to aſtronomers, and this may ſerve as an intimation to thoſe, who ſhall hereafter ſee them, what is to be done. Now with regard to this of Gaſſendi, let us ſuppoſe the daily motion of the ſun at one degree and twenty-nine ſeconds, that of Mercury at one degree and twenty minutes in longitude, and at twenty minutes in latitude; it will appear, that Mercury paſſed that day at two hours and thirty-one minutes after midnight through his node, which appeared in fourteen degrees, fifty-two minutes of Scorpio, the ſun being at that time at fourteen degrees, twenty-one minutes and a half of that ſign. We ſhall find, that the entrance of Mercury on the ſun's diſk ought to have happened at twenty-eight minutes after five in the morning, and that its true conjunction was a little beyond the middle of that trace, on the diſk of the ſun, where Mercury paſſed at eight minutes after ſeven, its true place, as alſo that of the ſun, being at fourteen degrees and thirty-ſix minutes of Scorpio, with a north latitude of four minutes and thirty ſeconds.

This is the reſult of Gaſſendi's obſervation; and in order to bring it to uſe in a proper and perfect manner, we are to examine the elements on which Gaſſendi calculated his obſervations, and to determine, by other obſervations, alſo the quantity of its motion, and the inclination of its orbit. At firſt ſight we may perceive, that the place of Mercury, as determined by theſe obſervations, is no leſs than four degrees, and twenty-five ſeconds diſtant from that which reſults from Ptolemy's tables; five degrees from the Pruſian; ſeven degrees and thirteen minutes from that, according to the Daniſh; one degree and twenty-one minutes from the Lanſberg, and only fourteen minutes, and twenty-four ſeconds from that of the Rhodolphan tables. Theſe laſt mentioned tables give the obſervation with a preciſion greater than Kepler, who was the author, preſumed to expect: for in the explanation, which is at the beginning of his ephemerides of 1617, he does not venture to aſſert, that his calculation will repreſent the place of Mercury in his conjunctions with more preciſion than that of one day, in which time the place of Mercury, ſeen from the ſun, may vary no leſs than five degrees, and his place ſeen from the earth, which is retrograde, one degree and twenty minutes; ſo much better will events be than expectation.

The ſecond view of the paſſage of Mercury over the ſun was on the twenty-fourth of October, in 1651; this was ſeen at Surat forty minutes after ſix in the morning by Skakerly, and muſt have been viſible at London at eighteen minutes after one in the afternoon. The third tranſit of Mercury was that obſerved by Hevelius on the third of May, in 1661,

1661, at Dantzick; he saw the planet on the sun's disk at four minutes after three in the afternoon, and observed it till thirty-one minutes after seven. This transit has been extremely accurately set down, and has been referred to by all the astronomers since, in their systems of the planet.

The fourth transit of Mercury was on the seventh of November 1677; Halley took an observation of this at the isle of St. Helena, and Gallet at Avignon. On the tenth of November 1690, Mercury passed before the sun for the fifth time, since this perfection of astronomical observations. This was observed at Canton by the jesuits, and at Nuremberg, by Wurtzelbourg. In 1697 a sixth passage of Mercury was observed at Paris: from this time we hear of none till the year 1723, on the ninth of November; this was observed in most parts of Europe. On the eleventh of November 1736, there was another transit of this planet over the sun's disk observed also in many parts of Europe; it is from the result of these observations, compared together, that we owe the present theory of this planet, which, however, we must acknowledge to be more imperfect than that of any other, and one of the desiderata in astronomy.

The Greeks, who are for having the origin of all astronomy to be supposed their own, give parts of their own history, or fable, to explain each of the constellations, and even deduce the origin of all the planets from some of their gods, or heroes also. As they made the world believe the Lion was the Nemæan savage of that species, and gave the name of Hercules to the figure of a kneeling man, which they had received without a name from the Egyptians (for they taught the Greeks the rudiments of astronomy) they made the planet, which they called Phaethon, that is, our Jupiter, to have been one of Prometheus's men, whom he had made so beautiful, that the gods thought him too perfect for earth, and called him up into the skies, there establishing him in form of that planet, excelling all the rest in beauty and purity of light. This is a singular circumstance, and from this, among other things, we may know that the Greeks received their astronomy from the Egyptians. Venus is a brighter planet, and most people would have been for making that the star, into which a man was exalted, for the sake of the elegance of his figure; but the Egyptians first observed the colours of the planets, they found Venus to be yellowish, Saturn bluish, and Mars red. Jupiter was the only one quite pure and unstained, and it was therefore they gave it the name Phaeton. This, tho' very little regarded, is a real circumstance with respect to the planets, and even the fixed stars have also different colours, tho' in a less degree, and this the Egyptians of old observed, and this their followers in opinion, the astrologers of all nations, have also observed; and it is this they mean when they say, certain stars are of the nature of certain planets, and influence things in the same manner. They mean, that certain stars have the yellow tinge of Venus, others the ruddy colour of Mars, and so of the rest; and they judge them of natures answering to their colours.

As the Greeks made Jupiter the transformed state of the handsome Phaethon; Saturn, whom they called Filius Solis, they supposed to have been the other Phaeton, the son of Phœbus. When Jupiter had destroyed him for misguiding the chariot of the sun, they say, his father took him up into the skies, and made him this planet, whom he placed farthest of all from that luminary, which had occasioned his destruction. Mars, they say, was Hercules, taken hot and burning from the pile, and so retaining the fiery colour.

Venus, which they called alſo Heſperus, was, they ſay, a youth alſo once. Heſperus, a ſon of Cephalus and Aurora, who diſputed the prize with the goddeſs Venus. And this Mercury was a mortal alſo of that name, who invented the diviſions of the year into months and weeks, and whom, from his continued obſervance of the ſun during his life, they ſuppoſed him transformed into a planet, and placed ſo as to be always near him. Others give the invention of months to their god Mercury, and ſay, the planet was only called after him for that reaſon. It has been already obſerved, that the light of the other planets is in ſome degree coloured, excepting that of Jupiter alone; Mercury is very little ſo, but what it is, is bluiſh, though not the ſame tinct with Saturn's, his is aglaucous or greeniſh blue; the little that Mercury has is true and pure blue.

MERKOLIS. A name by which ſome, who are fond of uncommon words, call the planet Mercury. It ſeems a barbarous word, but it is to be met with in ſome authors of credit.

MERIDIAN. A circle ſuppoſed to be drawn through the pole, and through the point of the heavens, which is immediately over our heads. This point of the meridian over our heads is called the zenith, and that point, which is immediately under our feet, is called the nadir. *See* CIRCLES *of the Sphere.*

GREAT MERIDIAN. On the meridian of places depends the meaſuring of their natural day, the ſeveral parts of which are conſequently the ſame with reſpect to all places that are under the ſame meridian. The aſtronomers count the natural day from noon to noon, they do not begin it at the ſun-riſe, becauſe that is a leſs determinate thing, but at the moment the ſun comes to the meridian, and the ſpace of time which paſſes between the noon of one day and the noon of the day following, is what they expreſs by the term a natural day. It is a conſequence that, as the day begins at the moment of the ſun's coming to the meridian, the day is the ſame in all places under the ſame meridian; that is, the ſun coming to the meridian, or, it being, in other words, noon in all theſe places at one and the ſame moment, it is one o'clock, two o'clock, and ſo on, for the whole day and night, exactly at the ſame point of time in every other place under the ſame meridian.

On the place of the ſeveral meridians depends alſo what is called the longitude of any place. When we conſider the meridian of a place, it is not only the time of the day, or the coming of the ſun to any given point in the heavens, that is the ſame in all of thoſe places which lie under the ſame meridian, but all thoſe places are alſo ſaid to have the ſame longitude; and the ſpace between one and another meridian, is the meaſure of the longitude of the ſeveral places to which the meridians belong. This diſtance, when places are marked drawn upon a globe, is to be meaſured upon the equator in degrees, minutes, and ſeconds, if that be neceſſary; and how many ſoever degrees and minutes the meridian lines of the two places are diſtant upon the equator, ſo many degrees are the places under thoſe meridians upon the globe of the earth diſtant from one another in longitude. This longitude may be either abſolute or meaſured, with reſpect to ſome one fixed meridian; or it may be relative or reſpecting the place mentioned as that of the immediate diſtance; and as there are places on each ſide of every meridian, that is, places to the eaſt, and places to the

the weſt, it may be meaſured in degrees eaſt, or degrees weſt, of the place named. Thus it is frequent to ſpeak of the diſtance of places in longitude from that place where the obſerver is, and this is naturally counted eaſt and weſt, as it is more familiar and ſooner done, not by following the courſe of the equator round the earth, and coming to within a few degrees of the ſame place again. To know the diſtance of longitude of one place from another, the method is to ſee the meridians of the two places, and to obſerve where they cut the equator, and at whatſoever number of degrees diſtant they do that, this number of degrees is the meaſure of the diſtance. Thus ſuppoſing the obſerver to be in London, and any place, at ſome diſtance, to be conſidered with reſpect to its diſtance in longitude, he conſiders the meridian of that place, and examines in what part it cuts the equator, and how far, as well as on which ſide of the meridian of London it falls on the equator. In conſequence of this, according to the number of the degrees between the places, it is ſaid to be ſo many degrees diſtant in longitude from London, and, according to the ſituation to the eaſtward or the weſtward, it is ſaid to be ſo many degrees eaſt, or ſo many degrees weſt, of London.

But although this is cuſtomary, and is proper enough with reſpect to any particular place, and any particular obſervation, yet there was ſomething more neceſſary where places were to be ſpoken of, as it were, in an abſolute ſenſe; as, when any part of the earth's ſurface was to be deſcribed with reſpect to its reference to the heavens, and when, with reſpect only to the globe of the earth, and not to the particular place where any obſerver chanced to be, it was neceſſary to ſpeak of its eaſtern or weſtern, as well as of its northern or ſouthern ſituation on the globe, in a ſort of expreſs terms, at leaſt in ſuch terms as ſhould be underſtood equally to all perſons, and in all places. As the abſolute diſtance north and ſouth could be named, becauſe of the abſolute place of the equator, which is one fixed circle encompaſſing the earth at equal diſtance from each of the poles, ſo in order to make the places eaſt and weſt abſolute and determinate, it was neceſſary, among the multitude of meridians that might be drawn, to fix upon ſome one which ſhould be the ſtandard, and ſhould, by way of eminence, be called *the meridian*, *the fixed meridian*, or *the firſt meridian*. The earlieſt aſtronomers found the neceſſity of this; and we find, among the Greeks, a circle fixed as the meridian, as fixed, and as certain, as the equator, from which, as from the other, all places were meaſured. Thus any place, or part of the earth's ſurface, being meaſured eaſt of the meridian, and north or ſouth of the equator, the globe being, by theſe two circles, divided into four quarters, the abſolute place of that point could be known in any of thoſe quarters.

As it was from the earlieſt time, and ſtill continues to be, the cuſtom to meaſure the abſolute longitude of places by counting the degrees of their diſtance eaſtward on the equator, it was natural for theſe people, who eſtabliſhed an abſolute meridian, or a firſt meridian, from which to meaſure the diſtance of all others, to make that meridian as weſtward as they could, that it might be a place from which to meaſure the longitude of all others, without the trouble of going quite round the globe; for as they meaſured only on the equator, eaſtward, according to the motion of the earth, if any place had been to be meaſured weſt of this meridian, it could have been done only by going quite round the globe, and ſo coming at it.

It was natural for the Greeks then to eſtabliſh this abſolute meridian, or firſt meridian.

This

This circle, which, like the equator, was to be a fixed line from whence to meaſure in the moſt diſtant part, weſt, they knew. We find they have done ſo. We hear them, with one voice, ſpeak of the fortunate iſlands as the moſt weſtern part of the earth that was then known, and accordingly they drew this firſt meridian, or fixed meridian, over one of theſe iſlands, which they named after Juno, one of their deities, and which is accordingly called, by the Greeks, Hera, and, by the Latins, Junonia. The meridian of this iſland was the firſt meridian, or the fixed meridian, from which the diſtance of all places in longitude was ſet down as their abſolute longitude, according to the degrees marked on the equator. This iſland of Hera and Junonia appears to have been one of the Canaries, (Teneriffe) an iſland ſufficiently remarkable for the vaſt mountain that is on it, and for that reaſon, had there been no other, very proper for this purpoſe. But being the moſt weſtern part of the world then known, it was for that, as the moſt palpable reaſon in the world, alſo choſen for the meaſuring all places eaſt from it.

In a caſe of this importance about which to be ſettled, and of this abſolute indifference as to the place where, provided that it were ſettled, and were remarkable, it is pity all mankind ſhould not be agreed. The iſland of Hera, ſuppoſing it to be Teneriffe, as it does appear to be on all accounts, was as proper and conſpicuous as any, and the Greeks having fixed upon it, it were pity to alter it, becauſe it rendered all their writings the more familiar by being preſerved; but ambition, or even whim, are too powerful for propriety. The Arabs, ambitious that the ſtudy of geography ſhould be ſuppoſed of the improvement, if not of the origin, of their country, would have the firſt meridian taken from them. Thus they fixed it to be the circle under which lay the fartheſt ſhore of the weſtern ocean; but there was great impropriety in ſuch a choice, ſince, of all places in the world, a ſhore is the leaſt fixed. We ſee in a few ages the ſea, in ſome places, receding from the land, and in others gaining upon it, and each to a great diſtance, ſo that the choice of a ſhore for the great meridian, was, at the beſt, not a thing of ſuch preciſion as that of a mountain, or ſome other fixed and remarkable point. But this is not the only variation that has been made in a thing in which ſameneſs was ſo much to be wiſhed. Corvo, one of the Azores iſlands, has been ſince made the place of the great meridian, and this from an apparent reaſon; the needle at that time pointed directly north, without any variation, on the iſland of Corvo, and this was the cauſe of their fixing on that iſland; but it has been ſince diſcovered, that the variation of the magnetic needle is, in itſelf, ſubject to variation, and conſequently the ſeeming great cauſe for the choice of this place, was not quite ſo concluſive as it appeared.

After this it became a cuſtom, to give up this abſolute meridian, and indeed when it had been unuſed from time to time, the firſt ſteps had been taken, for it was no longer any thing when unſettled, and different with different people. From this time every writer came to make the great meridian, or the firſt meridian, or that from which he meaſured, the meridian of the place where he lived, or where he made his obſervations. Thus, if a Frenchman writes, he makes the great meridian that of Paris; if a Dutchman, it is that of Amſterdam; and if an Engliſhman, that of London. In this, however, ſome of the late are much more to be priſed than ſome of the early geographers; for the French, in particular, who are moſt accurate obſervers, inſtead of ſhewing it, like the Arabs, an alterable ſhore of the ſea, or

even a city, which is alſo to be altered by addition of buildings, have, with a juſt preciſion, made it the meridian line, which paſſes through the royal obſervatory there. There have been attempts to recover the old meridian, and Bleau in particular has revived it in his tables, and has added the neceſſary preciſion by making it the meridian line, not of that iſland in general, but that which paſſes through the pike of Teneriffe, or the middle of the ſmall top of that mountain, a place ſufficiently remarkable. This, however, is diſregarded. It anſwers the private purpoſes of calculators beſt, and it is at the ſame time moſt familiar to let the firſt meridian paſs through the place where they live, at leaſt to meaſure all diſtances in longitude from the meridian of that place, and it has been the common practiſe ſince. Thus we, who write in London, when we ſpeak of the diſtance of places in longitude, mean their diſtance from London in longitude; and ſo do the maps and globes in general, which are made in London, expreſs it.

Though we have differed from the antients in the place of the firſt or great meridian, yet we have continued their courſe of meaſuring; and at this time, as in theirs, it is done only eaſtward. So that the longitude of any place is marked by figures, expreſſing the number of degrees, which are to be counted eaſtward, upon the equator, between the firſt meridian, be that where it will, and the meridian of that place. It follows, as already obſerved, that all places, which are under the ſame meridian line, are at the ſame diſtance in longitude from the firſt, and from this follows a very ſhort and familiar way of knowing the degrees in longitude of a vaſt number of places at one time, ſince the numbers upon the equator at the point, where the meridian of any one place interſects it, give the diſtance in longitude, not of that place only, but of all thoſe places which are under the ſame meridian.

Meridian, *of any Place*. A circle drawn round the earth in ſuch a manner that it paſſes through the two poles of the earth, and through the place whoſe meridian it is. There is a cuſtom alſo of ſpeaking only of one half of this under the name of the meridian; and when this is the form of expreſſion, the other half of the circle is called the oppoſite meridian. In this ſenſe they uſe the term as the meridian of the places which lie under the half of the circle which they diſtinguiſh by the name; and as this is a fixed circle with reſpect to this firſt place and the two poles of the earth, it is altogether fixed, and is called the meridian of all thoſe places, or they are ſaid all to lie under the ſame meridian.

The meridians may therefore be as many as people pleaſe. With reſpect to the equator, or the line, they differ in this; that being only one ſingle circle at equal diſtance from the poles, but in this each meridian agrees with the equator, that as the equator divides the earth into two hemiſpheres, a northern and a ſouthern, ſo does the meridian, through whatſoever place it be drawn, divided into two hemiſpheres, an eaſtern and a weſtern. When the meridian of the place is directly pointed at the ſun, which, by the revolution of the earth, happens once in twenty-four hours, it is then noon at that place.

MEROE, *Climate of*. A name given by the antients to one of the ſeven climates, or diviſions, north of the equator, into which they diſtributed the ſurface of that part of the world that was known to them. The climate of Meroe was the firſt of theſe ſeven, it began in that parallel where the length of the longeſt day differed half an hour from that.

Meroe

Meroe was ſuppoſed to be in the middle of this climate, and it was always their cuſtom to name their climates from ſome remarkable place, which they ſuppoſed in, or about, the the middle of each.

MEROPS. A name by which ſome of the old aſtronomers have called one of the conſtellations, the Eagle; the ſtory, they have for it, is, that this Merops, a king of Coos, obtained the conſent of one of Diana's nymphs to marry her. The goddeſs, they ſay, ſhot her with one of her arrows, which is that preſerved in the ſkies juſt above the Eagle; and Juno, after many miſeries, transformed him into an eagle, and in fine gave him a place in the heavens. *See* AQUILA.

MESTIERI. A name by which ſome have called the planet Jupiter; it is its Arabic name.

* METEORS. Certain tranſient appearances in the airy region of different nature, form, and effect; but all confined to that ſpace. It is true that many of them ſeem, to the ignorant, to be formed in the ſtarry heavens, and ſo fall from thence into our atmoſphere; but thoſe who have but the ſlighteſt knowledge of the ſtructure of the univerſe, will ſee this to be a vulgar error. They are all confined within the bounds of the earth's atmoſphere. That the moon has no atmoſphere is almoſt certain from obſervation; that the planets have not is too much for us to ſay, but, if it be ſo, they are too remote for our obſervation. So that all of which we read, or concerning which we can ſpeak, are belonging to the ſyſtem of our own earth, and are formed within the compaſs of its atmoſphere, and of its vapours.

Among the meteors there are many very curious, though not permanent, and aſtoniſhing, although they have no ſtable foundation. It is impoſſible indeed that they ſhould, ſeeing they are formed of vapours only, which, as they have been collected by accident, are eaſily diſſipated again, and muſt diſappear when this happens; in the ſame manner as thoſe which owed their appearance only to their being on fire, muſt as ſoon as they are extinguiſhed. There have not been wanting thoſe who have referred the comets to this claſs, nay, ſome of great and deſerved character in the times have countenanced the error, and ſuppoſed that they were only vapours illuminated at once, and burning till they were waſted, and ſeen no more.

It has been ſufficiently proved, under the head of the comets, that they are bodies of a very different kind, being indeed no other than planets of a peculiar order, revolving about our ſun, but in very long ellipſes, and viſible to us only in that part of their courſe in which they are near the ſun, and are ſubject to his influence. We are therefore to ſeparate the comets from this claſs of appearances, and, with this exception, we may aſſert, that all thoſe fiery, or luminous appearances, which ſhew themſelves on a ſudden, and laſt only for a time, are meteors. It is hardly neceſſary to add to the exception, thoſe phœnomena in the ſtarry region called new ſtars, ſuch as that in Caſſiopeia, and ſome others of leſs note, theſe being eaſily perceived to be quite out of our ſyſtem, and truly of the number of the fixed ſtars among which they are placed.

All other luminous appearances, which laſt only for a time, are meteors; they are formed of collections of vapours and exhalations from the earth, and are elevated to a certain height in the air, but within the limits of our atmoſphere. Theſe may become luminous two ways, they may reflect to us the light of the ſun, or other luminaries, or they may take fire

themselves several ways. In the first case, they continue luminous, provided the light fall properly upon them until they are dissipated; in the other, until they are burnt out. An examination of a few of these will serve to convey a general idea of the manner in which they are produced, and of their nature.

Thunder and lightening are of the number of meteors, and they are also of the nature of the most frequent and most considerable; the matter of these is doubtless formed of sulphureous and nitrous exhalations from the earth, which being elevated to a considerable height, and agitated in the region of the air, became enflamed, and waste themselves with a flash and noise, not unlike to that which accrues from the mixture of the same principles with charcoal in the making of gunpowder, when any way enflamed.

The first which we occasionally see in the air appearing for a different degree of time, and under a variety of circumstances, are different in themselves in quantity, and not less in quality. The quantity will make lightening more or less great and terrible; but the quality of it will also have a vast effect on the manner of its operations. As it is more subtile, and more nearly related to the pure etherial fire, it will have the more surprising effects; and as it is more gross, and loaded with particles, such as we know to have place in ordinary fire, its effects will, in proportion, the more resemble those of that common fire. Thus we see lightening sometimes so subtile, that it will kill without any visible mark, and will melt a sword without injuring the scabbard; at other times it will burn whatsoever comes in contact in the manner of common fire; and the hurts which those receive from it, who escape with life, are exactly such as are occasioned by burning with any material, or ordinary fire, and surgeons cure them in the same manner. At other times the effects are very different: nor are these to be attributed only to the nature or quality of the fire; the manner of its descent will also make great differences; it sometimes expands at once a large surface in a broad and less powerful blaze, sometimes it is driven along in a narrow stream, with a prodigious force; and in some cases it is more moderate in its motion; in others, its rapidity is astonishing. The duration of lightening is also as variable, sometimes it is instantaneous, and disappears the moment it is seen, and, as the poet expresses it,

Doth cease to be e'er one can say it lightens.

At other times it is more durable. We frequently hear of its falling in a solid globe as it were, or in a compact mass, which shall continue in its form some moments, and if it meet with any thing in its course, shall break into two or more parts, yet holding together in the several parts for some time; these will run about with violence upon the ground, and at length dissipate themselves with or without noise. Sometimes the crack at their bursting is violent; always a smell of sulphur is left behind them.

The lightening, in these cases, approaches to the nature of those other meteors which are fiery in their nature and appearance, and which, being produced without thunder, remain a long time in the air with greater or lesser motion, and at the length dissipate themselves usually without noise, but sometimes with a great crack, and not unfrequently with mischief.

Bodies, or masses of fire, of this kind, have been seen of two, three, or more yards in diameter, elevated to a very considerable height, and

and pursuing their course slowly for ten or twelve hours together; these are so uncommon, however, that, like comets, they are taken by the ignorant for presages of something fatal. The city of Barcelona was, in the last century, alarmed with such an appearance, which lasted the whole night, and, by degrees, dissipated itself about sun-rise; these some have called *tuns of fire*.

Somewhat of kin to these, but more violent, although smaller in extent, are what are called lances and spears of fire; these are usually of an oblong figure, their magnitude very various, and their motion swift; they have a brightness that will obscure the light of a full moon; they are seen continuing their course in a strait line in any direction, and are visible sometimes for near half an hour, often only for two or three minutes. They are generally at some height in the air, but are often so low as to terrify people extremely in their passage; often they do not run more than half a mile, sometimes eight or ten miles. When they are near the earth, their motion is attended with a noise like that of the mounting of a sky rocket; they always burst at last with a violent noise, often not inferior to the report of a cannon, and generally disperse into an innumerable quantity of rays. These also are looked upon by the vulgar as portents and signs; they are a kind of natural fire-work, seldom doing any harm, and very pleasing in the observation.

The column of fire is another of the meteors of this kind, it usually makes its appearance in an evening, and sometimes continues many hours; more frequently, however, its duration is but of ten or a dozen minutes, the height and the thickness of these is different, but, in general, those which have the largest diameter are of the shortest duration; these usually burst with a crack, equal to that of a cannon, the smaller often continue till they dissipate by degrees without any explosion. The people of Thorn in Lithuania were alarmed with the appearance of one of these pillars of fire in 1725, and presaged, as usual, the most terrible events from its appearance.

Nothing is so frequent as the little ball of light which we see in a summer evening in the air, lighting itself in a moment, and in another extinct, pursuing in the mean time a course along the heavens, oblique, or toward the earth; these are what we call shooting or falling stars. They are fires wholly of the same nature with those, which in the larger masses appear so formidable to mankind, although, in those little portions, they seem rather amusing. When a little parcel of inflammable vapour takes fire, with no more of the same kind near, if the agitation throws it forward, it goes on with violence, if not it falls, and as it continues burning so long as any part of it remains, it marks its passage by a lucid train, leaving indeed all the way a part of its body burning behind it. We see these only in an evening, or in the night, because the air is dark enough to shew them distinctly; but there is no doubt but that they are falling, and shooting also by day-light, only their light is not so strong as to be visible. There do not, however, want instances of this; some of them have been so bright, that, although little larger than the rest, they have been visible in an evening while the sun was yet up. Gassendi tells us of one of them which he saw fall in form of a body of white flame.

The parhelia, or mock-suns, are also very beautiful appearances of the meteor kind, but they are not frequent. We principally hear of these toward sun-rise, or sun-set, and there are the appearances of two or three suns in the

place

place of one, in this case the true sun is always in the middle: the mock-suns, which we see beside it, are formed by clouds, composed of subtle vapours, but those of so much density that they reflect the image of the sun in the manner of mirrors.

The paraselenes, or mock-moons, are of the same kind also, and properly come under the rank of meteors, as do also those circles which we call Halos. A kind of luminous cross is also formed from the moon at times, and with this the appearances of those mock-moons in all respects like to the mock-suns; these appearances are much more common in Iceland, and very far north, than in this part of the world.

To the meteors, we are to add also the rainbow, full of all the colours in their greatest beauty, and the Aurora Borealis, whether in a broad flood of light, or in streams, and waving spears. And to conclude, we are to enter also among the list, those lambent fires which are so frequent in marshy countries, and which are called *will o'the wisps*; these are usually found about stagnant waters, and they are so low that it is not uncommon for people who travel in the countries where they are frequent to pass among them unhurt. In Lincolnshire men often see them settle upon their own cloaths, and on the mane of their horse, and may wipe them off with the naked hand, for they do not burn.

METONIC CYCLE, *or Cycle of the Moon*. A cycle of nineteen years, calculated by the old Greek astronomer Meto, and called after his name. Meto lived in the eight-sixth olympiad, and is celebrated for having made many improvements in the early astronomy.

MICHAEL, *or* ST. MICHAEL. A name given, by a set of fantastical writers, to one of the northern constellations, the Little Bear. Schiller is at the head of these; he will have every constellation refer to some story in the bible, or of the histories dependant on the bible. He makes this St. Michael; others more moderate, retaining one or other of its antient figures, adapt some proper part of the scripture story to them. Some continuing the figure of the Bear, say it is one of Elisha's Bears, and others call it, according to the original form, the Waggon of Jacob, and Chariot of Joseph.

* MILKY WAY. A vast tract in the heavens, distinguished from the rest by its white colour, whence it obtains the name. The occasion of this distinction of appearance from the rest of the hemisphere, is readily discovered by the telescope. The whole space, when examined with that instrument, is found to be full of little stars; these are too minute to be seen by the naked eye, but they give a blended light, which together forms that milky appearance.

MILINUS. A name by which some have called the constellation Cygnus; it was a received name for it among the Latins; for we find one and the other poets speak of it by that denomination.

MINCHIR AL ASAD. A name given by the astrological, and though not much to their credit, by some of the astronomical writers, to the star in the front of the Lion's head, toward the top of his nose; it is the Arabic name, and signifies, in that language, the Lion's nostrils. Nothing is so contemptible as the retaining the Arabic names in our catalogues. Fomahaut is another of them; it signifies only the mouth of the Fish, the place where the star, so called, is situated; and to what purpose should it be preserved?

MIMKARALGERAH. A name given by ſome to a ſtar in the beak of Corvus.

MINORITY, *in Ratio's.* When two quantities have a ratio to one another, the firſt or antecedent is leſs than the conſequent; it is called a ratio of minority. *See* RATIO.

MINTACA, *or* ALMENTACA. A name by which ſome, who are fond of uncommon words, call the zodiac; it is the Arabic name for that circle of the heavens, and, in that language, the word ſignifies a belt or a girdle. All nations have called the zodiac by ſome ſuch name.

MINTAKA AL GIACENA. A name given by ſome, who are fond of uncommon terms, to the ſtars which form the belt of Orion; they are ſo conſpicuous in the heavens that it is not a wonder they ſhould be diſtinguiſhed by a peculiar name. Our ſailors, who know nothing of the conſtellation Orion, yet have a name for theſe ſtars, call them the Golden Girdle, or the Golden Yard, the laſt is the more uſual expreſſion. The Arabic name uſed by others, means only the belt of Orion.

MINUTE. Conſidered as a meaſure of ſpace, is the ſixtieth part of a degree; the degree being the three hundred and ſixtieth part of a circle. *See* CIRCLE.

MIRROR. A name by which ſome have called the bright ſtar in the girdle of Andromeda; they alſo call it Iſar, Mizar, Mizath, and Mizaz. Theſe are only ſo many corruptions of the Arabian word Mizar, which is the name by which they call this ſtar.

MISAN, *or* AL MISAN. A name by which ſome, who are fond of hard words, have called the conſtellation Libra; it is the Arabic name of that ſign, and the word, in that language, ſignifies a pair of ſcales.

MITRE, *or* MITRE *of St. Peter.* A name given by certain enthuſiaſts to one of the northern conſtellations. It is Schiller who has made this innovation; he has altered the Northern Triangle into this form, and given it the name of St. Peter's Ornament. Schickard is as eager as this writer to refer to ſomething religious in every conſtellation, but he is more pardonable in that he does not alter the figures; he preſerves the Triangle, but he gives it the name of the Trinity, of which he deſires it may be underſtood as an emblem.

MIXT ANGLE. Is that angle which is formed by the opening of two lines which touch in a point, and the one of which lines is ſtrait, and the other crooked. *See* ANGLE.

MIZACH. A corruption of the word Mizar; a name of the great ſtar in Andromeda's girdle.

MIZATH. A corruption of the word Mizar; a name of the bright ſtar in Andromeda's girdle.

MIZAZ. A corruption of the word Mizar; a name of the bright ſtar in Andromeda's girdle.

MO. A name by which Jupiter is called by the eaſtern aſtronomers. The proper ſenſe of the word is *Wand*, but why it is applied to this planet is not eaſy to ſay.

MOLOBOBAR. A name by which we find ſome, who love ſtrange and ill-ſounding words, call

call

the planet Jupiter. It is found in the writings of feveral languages, and always in the fame fenfe. But we find fome who fuppofe it to be only a barbarous way of writing the term Moloch Baal, a name by which many call Jupiter.

MOLOCH BAAL. A name by which thofe, who are fond of introducing hard names on every occafion, call the planet Jupiter; it is a term that we find indeed ufed by very early writers, but that is no reafon why late ones fhould ufe it. Voffius is of opinion, that the word Molobabor, by which this planet is alfo fometimes called, is only a barbarous pronunciation of this word.

MOMIMUS. A name by which fome, who will fearch very far after an unufual word, have called the planet Mercury; it is one of the names by which the Emiffæans called it.

* MONOCEROS, *the Unicorn*. One of the new conftellations of the northern hemifphere, or one of thofe which Hevelius has added to the forty-eight old afterifms, and formed out of the Stellæ Informes, or thofe which were not comprifed within the out-lines of any of the others. The Unicorn is a conftellation of great extent, but of lefs confideration than many which are fmaller. It makes a great figure in the maps and fchemes of the heavens, but a very moderate one in the hemifphere, it contains, in proportion to the fpace it occupies, fewer ftars than almoft any conftellation of the northern hemifphere. Thefe are not difpofed in the happieft manner that might have been poffible under the fame advantage of a better chofen figure.

The figures of the new conftellations are, in general, better drawn than thofe of the old, and that for a good reafon, the antients placed their animals in the heavens as hieroglyphics, and made them a kind of writing. The conftellation Virgo told men, that when the fun came into that part of the heavens the feafon of reaping was at hand, which fhe denoted by the ear of corn. The Ram befpoke the time of the breeding of that flock, and the Bull and Kids that of thofe animals. The antients, who had this defign in their figures, which they adapted to the feveral portions of the heavens, were pardonable therefore, if they put fuch as did not the moft happily, that could have been contrived, anfwer to the fituation of the ftars comprifed in them; and they were in this alfo, in fome meafure, pardonable, if, to make them take in the moft effential, they a little deviated from nature in the drawing: their bears with long tails, and their dragons with hairy heads, want this apology; but this is not the cafe with thofe creatures which we have put into the fkies. We have had no intent but to chufe a figure that might beft anfwer to the difpofition of the ftars, and take in the more confiderable of them into fome peculiar places; fo that we are unpardonable if we chufe fuch as do not anfwer to this purpofe, and if we do not keep to nature in the drawing; yet we do not always keep up to this.

When there were fo many real animals for Hevelius to have chofen amongft, it was very idle in him to fix on an imaginary one, and he is ftill lefs to be excufed in giving the drawing of this not agreeable even to the fabulous ftories. There is no fuch creature in nature as an unicorn, unlefs the rhinoceros is meant by that name; but thofe who have been idle enough to fuppofe there was another, have painted it as an horfe with a horn in its forehead. Inftead of this, the unicorn of the fkies is a long-bodied animal, with the divided hoofs of an ox, the head of an horfe, and a horn in the

the midſt of the forehead, which is ſtrait, long, and twiſted or wreathed, and exactly reſembles that tooth of the whale called the Narwhal, which is preſerved in many muſæums, and has been called, in the times of ignorance, an unicorn's horn. It is probably, to this ſingle thing indeed, that the whole ſtory of the unicorn owed its origin. People, who had been voyages to the north, found this tooth, which is white as ivory, and nine or ten feet long, upon the ſhores. The ſolidity of its texture preſerving it when the creature, to which it belonged, was waſhed to pieces. Not knowing what to make of this, they took it to be an horn, they brought it into Europe by way of curioſity, and thoſe who poſſeſſed themſelves of it fancied that it belonged to ſome animal, and therefore deviſed an imaginary quadruped to make out its hiſtory.

This is the true and proper origin of that animal which Hevelius has raiſed up into the ſkies. The place it holds there is between the head of the Hydra, Cancer, the Little Dog, Orion, the Hare, the Great Dog, and the Ship. There is, among theſe, a ſpace of conſiderable extent left in the heavens, and that is not quite ſo thick ſet as ſome others are with ſtars, yet there are enough in it to juſtify the forming a conſtellation, and to make it an uſeful one. The head of the Hydra comes juſt over the rump of the unicorn; the ſign Cancer is at a greater diſtance over its back; the Little Dog has its fore feet juſt at the inſertion of the neck, and hid under the mane; the horn of the unicorn comes behind the right hand of Orion about the wriſt, and its fore paws are very near his right hip; the Hare is at a diſtance below his feet; the head of the Great Dog comes under his ſhoulders, and his hind feet touch the maſt of the Ship.

In this vaſt conſtellation, Hevelius, who formed it, counted only nineteen ſtars, but Flamſtead has encreaſed the number to thirty-one. They are ſcattered irregularly as well as thinly over the figure, and they are none of them of the largeſt magnitude. The moſt conſiderable are ſituated as follow; there is one toward the tip of the ear, there are two over the eye, two about the mouth and noſe, and one on the lower part of the face, two behind the ear, and one on the out-line of the throat near the middle; there are four in a cluſter over the ſhoulder, and two lower, one in the middle of the body, three on the buttocks, two at the inſertion of the tail, and about four on the tail itſelf. Beſide theſe, there are three or four on the hinder legs, and one on the right fore foot, and another larger near the left; there are two little ſtars on that part of the horn that is near the wriſt of Orion. Theſe are all that mark the conſtellation in the heavens, ſo that its place is much better known by the conſtellations that ſurround it, than by the ſtars of which it is itſelf compoſed. It is indeed fainter in the expreſſion than almoſt any other.

MONSTER. A name, and a very proper one, for the conſtellation commonly called the Whale, for it is not at all like that creature. It has legs, and the head, neck, and breaſt of a quadruped, in all the figures that are given us of it. The Greeks ſay it was the ſea-beaſt which Neptune ſent to devour Andromeda, and which was killed by Perſeus. *See* CETUS.

MONTH-CLIMATES. A term uſed by the modern aſtronomers to expreſs thoſe climates which they have meaſured between the polar circle and the pole. The name is given them by way of diſtinction from that of thoſe which are meaſured between the equator and the polar circle, and which, being deter-

mined by small differences of time in the length of the longest day, are called hour-climates.

They reckon from the equator to the polar circle, as the antients did, by allowing the difference of half an hour in the length of the longest day between the parallels that mark the beginning and end of the climate; but in these, which are between the polar circle and the pole, the quantity of time that marks the difference by the length of the longest day, is necessarily greater. At the polar circle the longest day is twenty-four hours; and from this place, toward the pole itself, they add, on every division of a climate, the quantity of a whole natural day, instead of that of half an hour, as between the equator and this circle. As they advance more toward the pole, the day growing yet longer and longer, they find it necessary to add to the quantity which is the mark of encrease in the longest day in the same proportion. When they are arrived at that parallel, where the longest day is equal to fifteen days, they begin a new account. From this place they divide or measure the climates by an encrease of one of these days, which is equal to somewhat more than a fortnight, or to about the half of a solar month; and after this, by the encrease of twice that quantity, or of whole months: thus continuing to the pole itself, where the length of the day is equal to just that of half the year. This is the modern method of perfecting what the antients set about so rudely; they either supposed a considerable extent about the equator to be in the character of a right sphere, and so imagined it to have nothing to do with that obliquity on which all these changes depended; or else thought that part uninhabitable, and so not of any necessary consideration. However it was, one part of their imperfection, with respect to the division of the globe into climates, was, that they began only from that parallel where the longest day was twelve hours and three quarters; and the other was, that they never varied the encrease of time by which they measured, but kept it at the half hour in the longest day, and that they carried the admeasurement no farther than the Riphæan mountains. Ours is much more perfect, for we begin at the equator, and terminate at the pole itself, and, by the assistance of these month-climates, encreasing the quantity added as is necessary, we do all with great regularity, as well as great perfection.

The most accurate table of climates that ever was published, is Ricciolus's. It is natural to conceive, that, in comprehending a much greater quantity of the surface of the earth than the antients did, the number of climates, in a modern account, must be greater; but this is not all, the division is vastly more accurate, and the length of the day, on which all the punctuality of the division depends, is much more strictly ascertained.

This author has made the number of climates, in his division, twenty; and in the laying down the parallels, where they begin and terminate, he has used a caution, that all the other authors neglected; that is, he has made an allowance for the effects of the refraction of the atmosphere, which we know to be very considerable, and which yet none of the others have accounted for. This we know makes the sun appear higher than he is, and even shews his images after he is set, and before he rises; and, in consequence of this, the sun appears above the the horizon every day longer than he truly is, and so the length of day, that is, of the artificial day, (for this is the day by which we measure in counting of climates, and this is accounted by the hours which the sun is above the horizon) is greater in appearance, than in reality. Ricciolus,

ciolus, by making allowance for this refraction, has reduced the account to truth, and consequently acts in his division on a plan much better than any other. Besides, he has gone further than what has been already observed as the general custom of the moderns, in varying the quantity of the addition to the length of day at the several northern parallels, and, in the whole, has given a division vastly more accurate, as well as more judicious, than any other.

This author, whom it is best to follow in the whole division, begins at the equator, not at any distance from it, as the antients did, and taking up their division, he carries it as far as it can be continued with prudence. He then extends the addition not so abruptly as others have done, but continues what he has begun gently. His climates are measured by the addition of half an hour in the length of the day, till he comes to those of sixteen hours for the longest.

From this, which is his first point of changing, and a very proper one, he measures the climate by the addition of an hour to the length of the longest day, till he comes to that parallel where the day is of twenty-four hours. This is the beginning of another division, and from this he measures by the encrease of two hours to the longest day, till he comes to those of twenty-four hours. Here he begins the month-climates, which he measures by the encrease of half a solar month, or a little more than fifteen days to the longest artificial day. The general admeasurement of the modern writers has been mentioned already, and, by comparing that with this of Ricciolus, and taking in his regulation of the length of the artificial day, by the encrease of which they are measured, according to the laws of refraction, we shall see that this is the measure most to be depended on.

His climates are denominated like those of the antients, from some place, through which a parallel, marking the middle, is found to pass. Thus, the middle of the first climate north, according to his division, passes through the isle of Mindanao, and the first south through the isle of Ascention. In the first parallel, the height of the pole is two degrees and fifty-nine minutes, and the length of the longest day twelve hours and fifteen minutes. The middle of the second climate, north, passes through Goa, and of that south through the island of St. Helena. The third climate, north, has, in its middle, St. Luca in California, and the third, south, Assumption in St. Omer. The fourth has, in its middle, Cairo; and the fourth, south, Coquimba. The fifth climate, north, has, in its middle, C. Di Chille in the Morea; and the fifth, south, the mouth of the river De La Plate. The sixth climate, north, has, in its middle, the Alcalade Henraes, and the south, Baldinia; the seventh climate, north, has, in its middle, Asti in Pied; and the south the Coronatum Locus; the eighth climate, north, has, in its middle, Brisac in Alsace, and the south, Port Desire; the ninth climate, north, has, in its middle, Hamburgh, and the south, the middle of the streights of Magellan; the tenth climate, north, has, in its middle, Jeroslaw, and the south, Cape-horn; the eleventh climate, north, has, in its middle, Egrinculum in Tartary; the twelfth has, in its middle, the N. of Friezeland; the thirteenth, the S. of Iceland; and the fourteenth, the middle of Iceland. The others are in places not determined; but for the fifteen first, they may be very conveniently named, as the antients named theirs; as the ninth may be called the climate of Hamburgh, the eighth the climate of Brisac, and so of the rest.

* MOON. Notwithstanding that the moon appears

appears to the common observer larger than any of the heavenly bodies, it is the least of of them all. Things appear greater or lesser in proportion to their distance from the person who views them, and the moon is nearer, by multitudes of degrees, than any other of the heavenly bodies. We are indeed to look on this luminary in a light quite different from that in which we see all the others. The distance of the sun is immense; the planets roll round that sun as the earth also does, and are also very distant from it; the fixed stars are yet vastly more remote than all these; so far indeed, that their distance goes beyond computation, and we can make no conjecture about it. On the contrary, we are to regard the moon as not placed among these, nor revolving like the others round the sun; it revolves round our earth alone, and that at a little distance.

When we speak of distances under the term little, in regard to heavenly bodies, we mean comparatively with that of the others; for the least absolute distance when put down singly, will appear great, and the smallest magnitude immense. This moon, which is a speck, in comparison of the other heavenly bodies, and in comparison of their places, is so near to us; yet is, in her mean distance from us, more than sixty semi-diameters of the earth remote; or, in plain words, is distant from the earth two hundred and forty thousand miles, and its diameter is nearly a fourth part that of the earth's; it is about two thousand, one hundred, and seventy-five miles: the surface therefore contains no less than about fourteen millions of square miles. This, considered in itself, is a considerably large object; but when considered as an heavenly body, and in comparison with the others, it is little.

As the moon is the nearest to the earth of all the planets, her motion also is the quickest, the complete revolution being performed in about the compass of a month. This revolution of the moon is performed in an orbit, the plane of which is enclined to that of the ecliptic about five degrees, and cuts that of the ecliptic in two opposite points, which are what we call the moon's nodes. The ascendant node is that point of the orbit in which the moon is placed, when she is passing from the southern part of her orbit to the northern. The descendent node, on the contrary, is that point when she passes from the northern part of her orbit to the southern.

The moon appears in a great many different forms to the earth, sometimes more, sometimes less enlightned, and accordingly shewing more or less of her surface under the illumination. These different appearances of the moon, with regard to the earth, are called the different faces of the moon, and they are occasioned by the different position of the moon with regard to the sun, whence she is enlightned in a different degree.

The full moon, or opposition, is that state in which the whole disk of the moon is enlightned, and we see the whole of a circular figure, and all bright. The new moon, or conjunction, is that state in which the whole surface, or disk, turned toward us, is dark, no part of it being enlightned, or shone upon by the sun; in this state, consequently it is not at all seen. Astronomers call both one and the other of these faces of moon sizygies.

The first quarter of the moon is the state in which she appears in the form of a semicircle, the circumference of which is toward the west; and the last quarter is that state in which she appears to us in the same figure of a semicircle, but with the circumference turned toward the east. These two faces are called by astronomers quadratures.

The time between the new and the full moon is called the crescent, and that between the

the full moon and the new moon again the decreafe.

All thefe appearances of the moon will be eafily underftood, only by confidering the fituation of the earth, moon, and fun. The fun we know is placed at an immenfe diftance from us in the centre of the univerfe; the moon very near to us; the earth all the time making a revolution round the fun, and the moon at the fame time making a revolution round the earth. When the moon is between the earth and the fun, that half of her globe, which is turned toward the fun, will be enlightned, and all the half, which is turned toward us, will be left dark: this is the ftate in which we fee nothing of the moon, and it is one of the fizygies, called the conjunction, or the new moon. On the contrary, when the moon is got behind the earth, or the earth is between the fun and the moon, the whole furface of the moon, which is turned toward the earth, is enlightned; this is called the full moon, or the oppofition, and is the other of the fizygies.

When the moon is in a ftate juft between thefe, or is in her quarter, fuppofe the firft quarter, and is at ninety degrees from the fun, we can have only half of the enlightned hemifphere of the moon turned toward the earth; for we are to underftand, that one half of the moon, or one of her hemifpheres, is always enlightned, although we fee but a part of it. In confequence of the prefent fituation, we fee only one moiety of the difk of the moon, the circumference of which is turned toward the weft: and, for the fame reafon, when the moon is in her laft quarter, that is, when fhe is diftant from the fun two hundred and twenty degrees, according to the order of the figns, we can again fee only one half of her enlightned hemifphere, and fhe appears a femicircle, with the circumference turned toward the eaft.

In the other afpects, or fituations, although the moon be at all times enlightned in an equal quantity by the fun, yet in confequence of her different turning toward the earth, we perceive only a part of her difk enlightned, which part is encreafing all the way as fhe is departing more and more from the conjunction, and going toward the oppofition; and which diminifhes in the fame proportion as fhe moves from the oppofition to the conjunction. Thus fhe is continually encreafing in the enlightned part from the firft to the latter of the fizygies, and continually decreafing in it, as fhe returns from the latter to the former; this caufes that viciffitude of faces which we fee in the moon in each of her revolutions.

Thefe appearances demonftrate clearly that the moon is an opake body, deftitute of light in herfelf, and that what light fhe gives us fhe reflects from the fun. We do indeed, when the moon is in her encreafe, as well as in the decreafe, diftinguifh very clearly the opake part of her difk, which is not at all enlightned by the fun, and this has led fome very fuperficial perfons to imagine, that the moon had really fome light of her own, although the greater part were borrowed from the fun. But we are to confider, that as the moon being an opake body, cafts upon this earth a light reflected from the fun, fo this earth, being alfo an opake body, and enlightned by the fun, muft, in the fame manner, reflect that light in proper directions to the moon. This is indeed the cafe; and that faint light which we diftinguifh upon the darker part of the moon's difk at thofe times, is caufed by a reflection from the part of the earth which is enlightned by the fun, and is turned that way towards it. The effect which this has upon the moon muft be the fame with that which the reflected light of the moon has upon the earth.

When

When we view the moon by the naked eye, we see a great number of irregular marks on her disk, distinguished by their darker colour from the brighter, or more glaring parts: these are the moon's spots; and when we direct a telescope to its body, we not only see these much more distinctly, but we also perceive a great many others, which do not shew themselves to the naked eye. We distinguish very plainly by this assistance, that some parts of the moon's surface are plain, some elevated, and some depressed, or hollow; and more than this, we can distinguish among the elevated parts some that are level, and have the appearance of mountains, others rough, craggy, and abrupt like rocks, and we see also plainly a number of circles, or ovals, which have an eminence in the middle: we do not see these spots always alike. On the contrary, the different exposition of the moon with regard to the sun, and her different situation with respect to the earth, produce a diversity of appearance in all of them, and this very happily serves to give us means of distinguishing their true nature.

One of the first certainties at which we arrive in a course of observations on the moon's spots is, that there are mountains on its surface, altogether like to those on the earth; for when the sun is perpendicular to the place were any one of these stands, it does not cast any shadow; but when the light of the sun falls obliquely upon them, they cast a shadow on the side opposite to the sun, and that shadow is plainly perceived by our telescopes. Every shadow of this kind on the moon's surface is of a triangular figure, and terminates in a point; it is evident from this of what nature, and what form the bodies are which give those shadows.

In observing the several other spots on the moon's surface, which are of a circular, or nearly circular figure, of which there are many, we find that their part which is exposed to the sun is enlightned, while, at the same time, the other part of the spot is dark and obscure; we see that this is exactly the case with an hemisphere of any substance, hollowed and exposed to the light in an oblique direction; of a bason, placed upon a table, at some distance from a candle, in a room where there is no other light. We know what would be the effect of this. The part of the bason opposite to, or farthest from the candle, would be enlightned, and the contrary part of the cavity, or that nearest to the candle, would be dark. The laws of nature are fixed and invariable; the same shadows must be formed by light in the same direction on bodies of the same figure, and the consequence is very evident, that these spots, which give this appearance on the moon's surface, are really pits, or hollows. Thus much then is evident from the most plain observation, that there are mountains and caverns, pits, or hollows, on the surface of the moon.

The section of the moon, which distinguishes its enlightned, from its dark part, is the place which is, of all others, exposed most obliquely to the sun; it is in this part consequently that the shadows of those several eminences, which we distinguish on her body, are largest. We distinguish them therefore better in the quadratures of the moon, than in any of her other faces, because the shadows which at that time fall toward the centre of her disk, which is the part most of all exposed to our view, are most sensible. This happens from the same reason, that those spots of the sun appear the largest which are nearest to the middle of his disk, and are at that place also the most determinate and distinct.

These

These ſhadows of the eminences and hollows on the moon's ſurface, do alſo augment, diminiſh, and turn about, as the moon approaches toward the ſun, or recedes from it.

In the encreaſe, the moon being then in the eaſt, with reſpect to the ſun, the ſhadows fall to the eaſt; and, on the contrary, in the decreaſe, the moon being then occidental, with regard to the ſun, theſe ſhadows fall to the weſt, according to the true rules of optics and perſpective. We ſee alſo, by the aſſiſtance of teleſcopes, very often, certain little ſpots enlightned beyond the illuminated edge, and appearing as little flames, or ſpecks of fire, in the dark part; theſe reſemble ſo many little ſtars. This is an obſervation that convinces us not only that there are mountains in the moon, but that they are of very conſiderable height, ſeeing that their tops intercept the light, and become luminous, while their bottoms are yet dark.

It is a common thing to chuſe the full moon for obſervation by the teleſcopes, to ſee theſe appearances, but this is an error; it is of all times, when any part of the enlightned diſk is towards us, the worſt. At the full moon we cannot diſtinguiſh any ſhadows, for the whole diſk is directly oppoſite to the ſun, and in all its middle part there can be none; and as to thoſe which are found toward the edges of the moon, they cannot be perceived by us, becauſe we ſee the eminent parts on the ſame ſide with the ſun, and as our eyes, and its light, fall upon them in the ſame manner, the places where the ſhadows fall are hid from us. It is for this reaſon, that the ſame part of the diſk affords us a very different appearance when the moon is full, and when in the encreaſe, or in the decreaſe, for it is all one in which of thoſe ſtates ſhe is viewed.

Notwithſtanding, however, that in the time of the full moon the appearance of the elevations and depreſſions in its ſurface are wholly obliterated, we ſee a very different degree of light in the ſeveral different parts, and ſome appear to us vaſtly different from others; the occaſion of this diſtinction is, that ſome parts of the moon's ſurface are diſpoſed to reflect light much more than others. We ſee in ſome places ſpots of ſuch peculiar brightneſs that they ſeem to throw out rays every way from them upon the moon's ſurface; the three brighteſt of theſe are thoſe which aſtronomers have named Tycho, Copernicus, and Kepler; notwithſtanding theſe rays, which are, according to appearance, parts of the moon, elevated above the reſt of her diſk which is about them, do not diſtinguiſh themſelves, nor are ſeen the greater part of the encreaſe or decreaſe, but only at theſe times of the full illumination. This, however, may only be owing to their being leſs elevated than ſome other parts of the diſk, and conſequently interrupted by the ſhadows of thoſe more eminent parts, in the time when thoſe ſhadows are viſible to us. This difference of brighter and darker parts, which we diſtinguiſh in the time of the full illumination of the moon, has occaſioned the aſtronomers to give to the ſeveral parts the names of ſeas, lakes, and gulphs, continents, iſlands, and promontories; this has been done in conformity to the ſtructure of the earth, but it has not been done with a ſufficient degree of attention to the appearances. It would be very difficult to determine abſolutely whether there be water any where on the ſurface of the moon: that there are higher parts of the ſurface is certain, and we well diſtinguiſh them by the name of mountains; but as to the hollows, which might contain lakes, and other collections of waters, we palpably diſcover many of them to be empty: we do not pretend to aſſert, that there are not waters on the ſurface, there may

be

be collections of them large enough to obtain the name of seas; but assuredly it is not those spots which are called seas that have a right to the name: these are duskyer parts than the rest, and certainly seas would not be such. It is the property of water, though it absorb much, yet to reflect light strongly; on the contrary, less is reflected from these parts than from any other. It is more probable, that these immense tracts of the surface are rougher than the rest, since such spots would absorb the light more than any other, and consequently would reflect less.

Be it as it will, with respect to these particular conjectures, as to the particular parts of the moon's surface, there is great reason to believe, that the elements of which that planet is composed are very different from those of this earth; for we see nothing of those appearances, which must be the consequence of clouds, such as ours, if any such floated, at a small distance, as ours do, over the surface of the moon. We are so near to the moon, and we distinguish so well, by means of telescopes, what concerns that planet, that if there were clouds about it, as about this earth, we should, and must perceive the difference of the several parts as seen through them. The apparent configuration of the several parts of the moon's surface would be continually altered as they were seen through a clear air, through thin and light, and thro' dense and thick clouds; for the rays absorbed by them, and not reflected to us, would certainly cause a great difference between the appearance of a cloudy and clear prospect of any part of the moon: and as these clouds would be like ours, frequently changing place, the difference would be the more obvious. I have not advanced, as a certainty, that there is no water in the moon; but when it is observed, that in spite of nominal seas and lakes there is no real appearance of any, and we consider, that there also no appearance of clouds, the one circumstance corroborates the other in such a manner, that it appears the more probable.

As we see no appearance, such as ought to arise from clouds; so neither can we by any means discover that the moon has any atmosphere like to ours. The fixed stars, or the planets, when eclipsed by the interposition of the moon, do not suffer any alteration in their figure, or in their colour, at the time when they are getting behind the body of the moon, or at that when they are making their way out again. Now this can only be owing to the air, or etherial matter, being wholly the same, close about the moon, as at any other distance: we know, that the atmosphere which surrounds the earth up to a certain, and that a very considerable height, is of a different density from the air alone; and accordingly we know, that it makes changes in the appearances of bodies, and we are obliged to account for these in all our computations. If the moon had such an atmosphere about her, if the air surrounding her globe were different from that at a distance, we must necessarily see those changes in the figure and colour of the heavenly bodies passing through it when very near her edge, which are the natural and the necessary result of their being seen through a different medium. This is not the case, they are immediately before their immersion, and immediately after their emergence, seen just as at other times, and consequently there is no difference between the air just about the moon, and that at a distance from her; that is, the moon has no atmosphere.

Upon the whole, as there is no appearance of water, clouds, or atmosphere, on or about the moon, it is highly probable, that the matter of which her globe is composed, although

although it may be analagous to earth, has nothing in it resembling water. That there is nothing there to form exhalations, vapours, clouds, or meteors, such as we have about the earth, we inhabit, and there is nothing dissonant from reason in this. It is probable, that the primary intent of the moon's creation was to give light to us, and if this be her great and principal use, it is not a wonder, that the all-wise hand, which formed her orb, should have made it most capable of these effects; to this earth, an atmosphere, and meteors, are necessary, because it was to be inhabited, and the fruits of the ground, and the immediate life of all the inhabitants, were to be supported by them. This, as the earth was made for its inhabitants, was therefore a primary intent in its creation; but with regard to the moon, if we conceive the giving light to us, her great and her essential purpose, water was no necessary part to her frame; on the contrary, she is better suited to the purposes of the creation without any. The effect of water, influenced by the sun, would be clouds, vapours, and meteors; these could be of no use, and they would have obstructed her brightness. *For the revolution of the Moon about her axis, see the article* LIBRATION.

The antients represented the moon, as they did the sun, sitting in a chariot, and drawn by horses. The old opinion was, that one of these horses was black, and the other white, a motley equipage; but we find Homer, Hesiod, and, among the Latins, Ovid, mentioning it. They intended to convey by it some idea of the moon's being sometimes dark, and sometimes enlightned; but they were not so well agreed about her cattle, as her chariot. Claudian, to express the rapidity of her motion, makes them stags; and we find some very old writers, among the Greeks, who fix upon oxen for her. This is a point necessary to be explained, as there are passages in the writings of those times, not otherwise intelligible. Nothing is more frequent than the calling her the driver of oxen, Boum agitatrix Luna; and this would be unintelligible, if the testimony of old writers, and the countenance of antient medals, did not support the opinion, that her chariot was understood by many to be drawn by those creatures. Among the Latins, some represent her also as drawn by mules, and the reason they give for this devise, is a very extraordinary one. They say, it is to express, that the light is not properly her own, or generated of herself, but received from the sun, as the mule is not an animal, of a species of its own, as others are, but owing to a mixed generation; this was as odd a way of expressing her bastard light, the nothum lumen, as Catullus calls it, as that of a black and white horse, for the succession of light and darkness; but such people were these great antients, and to such conceits had they sometimes recourse.

* MOON'S *Houses*. This is a term which we shall frequently find in the Arabian astronomy, and it expresses those parts of the heavens which the moon came to every night; they were therefore twenty-eight in number, and they were arranged into one great circle. The Arabs called each of these by a peculiar name; and if the space in the heavens, described by it, were vacant, as was sometimes the case, it stood only for that space; but if there were stars in it, which was almost universally the case, these stars were called by that name; and to this is in part owing the great multiplicity of terms in the Arabian astronomy, in which lesser constellations are formed in the greater, and names are given to peculiar stars. They used the several parts of this circle also

for other purposes, beside that for which it was originally intended, and understood every house, as having some peculiar influence, either over the seasons, or mens actions.

MOSALSALA, *or* Al Mosalsala. A name by which some have called the constellation Andromeda; it is one of the Arabic names of that constellation. They call it also Mara.

MOSES. A name by which some have called the planet Jupiter. Schiller has been the inventor of all this folly; after he had altered all the constellations into scripture-pieces, he began the same innovation among the planets; Adam is Saturn, Moses the name of Jupiter, Christ of the Sun, the Virgin Mary of the Moon, and Mars is Joshua, Venus St. John Baptist, and Mercury Elias.

MOTHALLATH. A name by which some have called the Triangle; it is one of the Arabic names of that constellation. The signification of the word is a triangle.

* MOTION *Apparent, of the fixed Stars.* One of the first discoveries in astronomy was, that there was an essential difference between some certain stars and the generality of others. This was seen in the change of places of the few, while the others kept the same situation with regard to one another, and with regard to their absolute place in the heavens. The first kind, and which were only a few in number, were called erratic, wandering stars and planets; and the rest obtained the name of fixed stars.

Thus remained the doctrine of the heavens for some time. It was not till after many years, nay, many ages passed, before men discovered that even these stars, which they called fixed, and which their fathers believed to be so, had, in reality, a motion proper to themselves, and independent of their diurnal revolution round the earth; indeed in a direction contrary to that, namely, from west to east. This was afterwards called their motion in longitude. The first astronomers having observed the horizon, which is the only fixed circle we can name in the heavens, and considered these stars with regard to it, found, on repeated observations, that they rose and set at the same points of this horizon. They had made their observations for several years, and found them always in the same points; they naturally concluded that they always had, and that they always would, continue to rise and set in the same precise places; but the sons and successors of these astronomers, comparing the accounts and observations of their ancestors with their own, found that, in reality, it was not so. They saw that these stars did not, in their time, rise and set at the same points of the horizon as in their fathers, but that some of them had, in this period, gradually approached nearer and nearer to the points of the equinoxes, while others had receded farther from them. The natural result of this observation was, that the stars, hitherto called fixed, were not absolutely so, but that they had a motion peculiar to themselves; and that this motion was not made about the pole of the equinoctial, because they did not all of them preserve the same situation with regard to that pole.

It was observed also, that in the passage of the fixed stars through the meridian, their height above the horizon, and consequently their declination, with regard to the equinoctial, was subject to some variation; but that this variation was not uniform with regard to all the fixed stars. They found indeed that some of the fixed stars approached toward the equinoctial,

noctial, and others of them receded from it at the rate of several seconds in the course of a year, and this more or less according to their different situations with regard to the points of the equinoctial, and the poles of the world; and this in such manner that it was almost insensible in those which were placed in a certain quarter of the heavens, while it was thus considerable in the others. When they had considered all these appearances, they concluded, and indeed there was appearance to justify the conclusion, that these stars did turn about, or perform a motion of revolution in the heavens, and that this revolution was performed about a point which they fixed in the constellation Draco. This is, at this time, found to be about three and twenty degrees and an half distant from the poles of the equator; and is the same with what we call the pole of the ecliptic; the point round about which the sun seems to perform an annual revolution.

Ptolemy, after an infinite number of comparisons and observations, attempted to prove that the fixed stars had a revolution about the poles of a circle which passed through the middle of the signs, and that they always preserved the same latitude with regard to this circle. He records to this purpose the opinion of Hipparchus; who, by the comparison of his own observations with those of Timocharis, a man of fidelity as well as knowledge, made at the distance of an hundred and fifty-five years, found that the Spica Virginis, or ear in the constellation of the Virgin, had preserved, in all that time, the same distance with regard to the ecliptic, and not with regard to the equinoctial, its latitude having been, at all times, two degrees south. From this he concluded, that this motion of the fixed stars was a revolution about the poles of the zodiac; of this, however, he had some doubt, being not quite satisfied with the perfect precision of the observations of Timocharis, and not convinced that the time between the observations of Timocharis and his own had been enough to give him the opportunities of a perfect evidence. To this Ptolemy adds, that, for his own part, having had the opportunity of a number of observations made in a long course of years since the time of Hipparchus, and having found, according to all those observations, the motion of the fixed stars the same that Hipparchus found it, he was assured, that the fact was as that author had supposed it, and that the fixed stars did, in reality, perform revolutions about the poles of the zodiac. In this he was the more confirmed, because the distances of those stars in latitude, from the great circle described about the poles, appeared to be the same with those determined by Hipparchus, except for very little and inconsiderable differences, which were the natural result of the smallest errors in the observations.

It is by no means thus, continues Ptolemy, with the distances of these stars from the equinoctial; those which are in the hemisphere from the winter solstice to the summer solstice, that is, from the commencement of Capricorn to that of Cancer, being always more and more toward the north, and that of the opposite stars, in the opposite manner, more and more meridional; but this is in such manner, however, that those stars, which are nearest to the points of the equinoxes, have a greater motion of declination than those which are near the points of the solstices. This he confirms by observations which himself had made on many of the fixed stars, and which he compared with those of Aristillus, Timocharis, and Hipparchus. As to the quantity of the motion of the fixed stars in longitude, they could not determine it otherwise than by the comparison of different observations taken at the distance

tance of a great number of years. Hipparchus, who lived about a hundred and twenty-eight years before the date of the Christian æra, found, according to the report of Ptolemy, that, in his time, the Spica Virginis was six degrees distant from the equinoctial point, contrary to the order of the signs. Timocharis, one hundred and fifty-five years before, had found it at the distance of eight degrees from Libra in the same direction; from whence it appeared that this star had run, in the space of one hundred and fifty-five years, two degrees according to the course of the signs, and this he observed had happened in the same, or very nearly the same manner, to all the rest of the fixed stars.

According to this observation, the motion of the fixed stars, in longitude, appeared to be at the rate of a degree in twenty-seven years and a half; but, in the place of this, Ptolemy allows them a motion only of one degree in an hundred years; this was according to the sentiments of Hipparchus, who, as he says, observed, in general, that the fixed stars had a motion but of an hundredth part of a degree in a year, or of three degrees in three hundred years. To confirm this opinion, he asserts, that, in the second year of the reign of Antonine, that is, in the hundred and thirty-eighth year after the birth of Christ, the Cor Leonis, or star called the Lion's Heart, was two degrees and thirty minutes from that sign; and, at the distance of thirty-two degrees and thirty minutes from the point of the summer solstice. Hipparchus had found it, at the the distance of one hundred and twenty-eight years before the birth of Jesus Christ, at twenty-nine degrees and fifty minutes of Cancer; so that, in the space of two hundred and sixty-five years, or thereabout, which had passed between the time of Hipparchus's observations and his, this star had advanced two degrees and forty minutes, which is pretty nearly at the rate of one degree in one hundred years. He adds to this, that, according to the observations which he had made on the Spica Virginis, and several other stars of the zodiac, he found that the fixed stars, in general, had, from the time of Hipparchus to his own, advanced about two degrees and forty minutes according to the order of the signs.

Now to deduce the apparent motion of the fixed stars in longitude, from the true principles, and consider what it is, as well as to what it is owing, let us compare these observations of Hipparchus, who deserves the greatest favour for them, with such as have been made at or near the present time. As the Spica Virginis and the Cor Leonis, are conspicuous stars, being both of the first magnitude, and also of the number of the brightest of the fixed stars; Hipparchus observed these, the first at the distance of six degrees from the point of the autumnal equinox, contrary to the order of the signs; that is, in other words, at twenty-four degrees of Virgo, and the other at twenty-nine degrees and fifty minutes from the point of the summer solstice, or from Cancer.

According to observations made in the most accurate and careful manner, the Spica Virginis was, in the beginning of the year one thousand seven hundred and thirty-eight, at twenty degrees eleven minutes and forty-five seconds distance of Libra. The difference of this, from twenty-four degrees of Virgo, is twenty-six degrees eleven minutes and forty-five seconds; which, being divided, according to the term of one thousand eight hundred and sixty-six years, the interval, between the time of Hipparchus's observation and the year one thousand seven hundred and thirty-eight, shews the annual movement of this star to have been at the rate of fifty-minutes and thirty-

two

two thirds. The Cor Leonis, obferved, with the fame accuracy, in the year 1738, gave twenty-fix degrees, eleven minutes, and forty feconds for the difference, which being reduced to years, allows fifty feconds and fifty thirds for the annual motion; the difference between the two is therefore only eighteen feconds, and therefore taking the middle point between thefe two determinations, we fhall find the motion of the fixed ftars, according to the obfervations of Hipparchus, at fifty feconds, and forty-one thirds annually, and at the rate of one degree in twenty-one years, and a few days.

This does great honour to Hipparchus; but an exact obfervation, in comparifon with thofe of Ptolemy, does not fo perfectly and accurately agree with his peculiar opinion. By comparing the places of Aldebaran and Antares at this time, with thofe which he has fixed, according to his own obfervations, it appears, that the diftances are, as in the former obfervations, of the Spica Virginis, and Cor Leonis of Hipparchus, little different from one another; but in taking the middle quantity in this cafe, in the fame manner as in the other, we find the motion of the fixed ftars, refulting from the obfervations of Ptolemy, to be at the rate of fifty-two feconds, and forty-fix thirds in the year, or at about the rate of one degree in fixty-eight years, and three months. This is a quantity very different from what Ptolemy himfelf affigned them when he gave their motion at the rate of one degree in one hundred years, and approaches much nearer to that which refults from the obfervations of Timocharis, compared with thofe of Hipparchus.

Thefe obfervations of Ptolemy have been followed by thofe of Albategnius, who lived at about feven hundred and forty-one years after him, and one hundred and feventy-eight years after Chrift, and his were extremely accurate, as appears by comparifon; and from his time to that of Tycho Brahe, there were, at different periods, many more obfervations made on the places of the fixed ftars: and in the year one thoufand and fix hundred, Tycho publifhed his own, which are extremely accurate. On comparing the obfervations of Albategnius, the refult is, that the motion of the fixed ftars is fifty-one feconds, and thirty-one thirds a year, which is about a degree in feventy years; and Tycho Brache's own fet it at the rate of fifty feconds, and thirty-nine thirds, taking the mean of the obfervation for either; this latter account makes the motion of the fixed ftars in longitude to be at the rate of one degree in feventy-one years and fix months.

It is to no purpofe to compare the obfervations of the fixed ftars, made fince the time of Tycho, with thofe made at prefent by ourfelves, for the diftance of time elapfed is not enough to form any regular judgment; but it appears by the repeated comparifon of thofe of Hipparchus, Ptolemy, Albategnius, and Tycho, with thofe of our own time, it is plain, that the apparent motion of the fixed ftars in longitude is about a degree in between feventy and feventy-one years; and if any thing farther be to be added on the occafion, it is, that the motion of them appears to be, if any thing, fomewhat flower at this time than it was, fo at leaft feem to fay the comparifon of the later obfervations. However, to give the moft fair general rule that can be collected from fuch a multitude of obfervations, made at fuch diftant times, it feems, that, to fpeak in whole numbers, we ought to fay, the apparent motion of the fixed ftars in longitude, is at the rate of one degree in feventy years.

Motion *of the Sun, with regard to the Earth.* It has been the custom with astronomers to attempt determining the mean motion of the sun, before they had laid down rules for ascertaining his apparent, or, as some call it, his true motion; but it is better not to have so much to be supposed. The most intelligible method of treating a subject to those who are not before acquainted with it, is to begin with things the most known and most familiar, and pass on from such to those which are less known, and more abstruse. It will be the most eligible method therefore to begin here with the motion which the sun seems to describe to our senses, and which is called by some his true, and by other his apparent motion.

The most plain and easy way of determining what is the true or apparent motion of the sun is, to observe every day, for a considerable time, the centre of the sun in its meridian altitude. This may easily be done by means of a quadrant, or a gnomon, the height of which is known, and which will transmit the image of the sun upon an horizontal plane. This height is to be corrected according to the rules of refractions and parallax, and there will then be known the true height of the centre of the sun at its passage through the meridian. We are then to take the difference between the true height of the centre of the sun, and that of the equator of the place, where the observation is made, which we know to be the complement of the height of the pole, and we shall have its declination, which will be north, when the height of the sun is greater than that of the equator, and south when it is less; when this is done, the common method of resolving spherical triangles does all the rest. In the same manner, the longitude of the sun may be known for the day following, or for any other day required; and taking the difference between these two longitudes, we shall have the measure of the apparent motion of the sun for any required time.

MOVEMENT, *First*. A term used by some of the writers on astronomy in our language, to express the apparent diurnal revolution of the heavenly bodies about this earth; this is universal, and alike. In respect of all their annual revolutions, or those of any other period, whether apparent or real, they are not regular, nor are they so obvious; this includes even that of the sun itself. The term, *first motion*, by which this is expressed, is not the invention of those writers of our own nation who use it. We meet with terms of the same import among the earliest Greek and Latin writers, and indeed, in consideration of its meaning, it was much more likely to be the offspring of their conceptions than of ours. The occasion of the term was, that this motion was understood to be owing to the movement of what they called the primum mobile, and therefore the original motion of the heavens.

This was so obvious, that it was impossible for any to miss observing it. The effect of it was to be seen in all the stars; but these being like one another, might not be remarked enough, as separate, to point it out, till they were formed into constellations. But before this, or any other attempt in astronomy, or any consideration of the stars at all, the sun must shew this, for whoever saw him rise one day, saw him, after running the whole concave of the heavens, set at a certain hour, and at, or near the return of the same hour, at which he rose before, after having been hid so long under the earth, rise again. His setting must be also observed in the same manner to be at a regular period, and at whatsoever time of the day he was observed to be at the highest

part of the heaven, or in any other fixed and obſerved point of it, preciſely at that time, the next day he was found to be at the ſame point. Nothing could ſeem ſo clear, as it muſt appear from this, that the ſun every day revolved, or run round the earth; it was a miſtake indeed, for it was the earth's motion on her own axis that occaſioned it; but ſtill that motion being unknown, nothing could appear ſo plain as that the ſun ran round the earth in the ſpace of four and twenty hours. From this obſervation, it was eaſy to carry on the examination; and the conſequence probably was the perceiving firſt, that the moſt conſpicuous of the planets performed the ſame revolution in the ſame time: after his, that the reſt of the planets did ſo; and finally, that all the ſtars did the ſame.

What appeared ſo general, muſt be allowed ſome general cauſe, and, according to the eſtabliſhed opinion of thoſe times, no cauſe was ſo general, or ſo proper to produce it, as that of the imagined primum mobile. This general revolution therefore of all the ſtars, planets, ſun, and moon, round about the earth in the ſpace of twenty-four hours, was called the motion, depending on the primum mobile, and thence the firſt motion.

It was one of the firſt principles in thoſe times, that the earth ſtood ſtill, and was fixed in the centre of the univerſe; this was very natural to a firſt obſervation, and while it was received, and while little more than this diurnal revolution of the ſeveral heavenly bodies was obſerved, it was impoſſible to gueſs at any other ſyſtem. Could but the firſt hint have been given concerning the motion of the earth, people of this penetration would ſoon have known, that the appearances they ſaw would equally be ſeen whether it were, that the whole ſyſtem of the heavens did revolve daily round the earth in the direction in which they appeared to do ſo, or the earth itſelf turned round upon its own axis by a motion in a contrary direction. This is indeed the caſe; for the earth is now known to have this revolution, and what is called the firſt motion is known to be owing, not to any thing that really paſſes in the heavens, but to a revolution of the earth itſelf. The ſenſes alone of the antients could not lead them to diſcover this; for to the ſenſes, the effect is exactly the ſame, whether the heavens, with all their furniture, do revolve round the earth, or the earth move round of itſelf. The ſucceeding obſervations of motions, beſide this; of motions which were particular to each of the heavenly bodies, and which they did not agree, as in this general ſeeming one, firſt led to the diſcovery that this was only apparent, and what could not have been made out by the ſenſes, was a diſcovery of the reaſon.

It was diſcovered then, that the fixed ſtars, and that the ſun abſolutely ſtood ſtill, retaining their place for ever in the heavens, and that the planets revolved round this ſun. It was found afterwards, by additional obſervations, that this earth itſelf moved alſo round the ſun, performing that revolution in the compaſs of a year. But this was foreign to the conſideration of the apparent motion of the heavens, as performing their diurnal revolution: this required, in order to explain it at all, that revolution of the earth, upon its own axis, which was made all the while that it was running its annual courſe; which was made each time in the courſe of twenty-four hours, and on which alone the riſing and ſetting of the ſun, with other the moſt obvious appearances in the heavens, depended.

To explain this, they began to delineate the

the earth on paper, and to reprefent it in a manner more ftriking to the eye by a globe. Through this globe they reprefented an imaginary line to pafs from one furface to the other, and through the centre; this line they call the axis of the earth, round which it turns in the compafs of twenty-four hours; all the time that it is making its great circle, or annual revolution. On that great one depends the year, and that has been already fpoken of in its place. On this leffer depends the return of day and night, and the apparent motion of the heavens called the firft motion; this therefore is the place of explaining that. This axis, or line, continued through the earth, is the line round which the revolution is made, and as the two points at which it touches the furface are of great importance in relation to the fyftem, they are diftinguifhed by a peculiar name, and called the poles of the earth. Thefe terminate the two extremities of their axis, and the one of them is what we call the north, the other the fouth pole. Next after thefe, it became proper to conceive a circle, that fhould encompafs the earth exactly in its middle. This circle is imaginary, as well as thofe points; but we know exactly the place where it is conceived to be. This the aftronomers call the equator, and the vulgar the line; it encompaffes the whole globe of the earth, and that at equal diftances from the north and fouth pole. Thus was the general divifion of the earth, made into two equal parts, the one north of the line, or the equator, and the other fouth of it; and when in navigation the fhip paffes over the equator, the expreffion is, that it croffes the line.

When a beginning was thus made of points and circles conceived upon the earth's furface, it was as eafy to proceed, as it was neceffary to do fo, in order to explain any of the heavenly revolutions, or but to talk rationally about them. The earth, we fee, was thus, in general, divided into two hemifpheres, a north and a fouth, by the equator; it was neceffary to divide it on many occafions again into two hemifpheres, an eaftern and a weftern, by fome other circle. To this purpofe was invented the meridian, which is not like the equator, fixed, or always the fame, and only one, but was fuited to any place, and was conceived at pleafure by any perfon; the equator therefore was at all times the fame, it was but one and the fame equator of the earth. The meridian was different in every place: there might be conceived a thoufand as well as one, and it was not the meridian of the earth, fpeaking of it fingly, but it was properly expreffed by the term meridian of this or that place.

This line, or in proper terms, the meridian line of any place, is a circle conceived to be drawn round the whole globe of the earth in the manner of the equator, but in a direction exactly oppofite, as that is between the two poles, and at equal diftance from them both; this is drawn through them both, and becomes the meridian of the place for which it is named, by being fo drawn as to pafs through that place in its courfe.

After this another circle is conceived, that is, the horizon, a circle, in the centre of which the perfon, whofe horizon it is, ftands. This, like the meridian, is variable, and there may be as many horizons as meridians. As the meridian becomes the meridian of any place from its paffing through that place, fo the horizon becomes the horizon of a particular place by every way furrounding it. If it be a circle, whofe plane paffes through the place where the feet of the perfon ftands, and is extended to the heavens, it is called the fenfible horizon; if it be a circle, whofe plane paffes through the centre

centre of the earth parallel to that place, it is called the rational horizon. But these (so immense is the distance of the starry heavens) coincide, and become the same thing at the stars.

It will appear, from this account of these two circles, that the meridian of any place cuts the horizon of that place at right angles. By this are marked upon the horizon the north and the south points, and the whole globe of the earth is divided by it into two hemispheres, the eastern and the western. In order to understand the books on these subjects, it is, however, necessary to observe, that not this whole circle, but often only half of it, is meant by the term meridian, as it occurs in the several writers. The two poles of the earth are the two points through which this circle, be it drawn for what place it will, must pass, otherwise it is not a meridian. Now these two circles, being at equal distance on the surface of the globe, divide any circle of the globe that passes through them into two semicircles. The one of these semicircles is then drawn through the place whose meridian it is, and that semicircle, in which the place stands, is understood to be the meridian of the place when only one of the two semicircles is called by the name of the meridian. The other semicircle passes through that point on the surface of the earth, which is exactly opposite to the place whose meridian the whole is, in general, said to be, or whence the other semicircle is, denominated.

When we consider only the semicircle, in which the place, whose meridian it is, stands, as a meridian, we say, that all other parts of the earth's surface within that compass, and being under that semicircle, that is, all other places through which it passes, as it does through that for which it was drawn, lie under the same meridian. When the one semicircle is thus dignified with the name of the whole circle, and that in which the place stands is called the meridian, the other half of the same circle, passing over the several opposite parts of the earth, is called the opposite meridian; or, by some, the opposite part of the meridian. This necessarily arises from taking a part under the name of the whole.

We shall now be in the way of understanding, in another manner, what is called, by the antients, the first motion, and was by them conceived to be owing to the motion of all the heavenly bodies round about this earth. It has been already observed, that, whether the whole frame revolves round about the earth, or the earth revolves about upon its own axis in a contrary direction to that in which the heavenly bodies are supposed to move, the consequence will be the same to a person living on this globe; that is, he will, in either case, see the sun, moon, and stars rise and set, and as all things on the globe move with him, he will not be able to distinguish whether it be the heavenly bodies, or that globe, that moves.

Now having observed, that the axis of the earth is a fixed line, and the poles of the earth, which are the points that terminate that line, are also fixed; if the place, the meridian of which was taken, be also a fixed spot upon the earth, a city, a tract of land, or a building, that being fixed, and the poles fixed, the meridian is also a fixed circle; for as it must necessarily pass through that place and those poles, it must be invariable in its own position: therefore, the earth making a revolution about its own axis in twenty-four hours, this meridian must make a revolution also with it, and that constantly, certainly, and equally. The sun's standing still in its place, its rising and setting, and all those other appearances, which, in compliance to custom, and the ordinary form of speaking, we call by peculiar

names,

names, as if they were fixed things, muſt be, in conſequence of the earth's revolution, dependent on it. Now this revolution being performed in twenty-four hours, the place for which a meridian was conceived, and together with it that meridian, ſince it is in conſequence of what has been already ſaid, a fixed thing, muſt, at ſome part of thoſe twenty-four hours, or in ſome period of that revolution, be brought to point at the ſun, and whenever they do ſo, it is then noon at that place. In this caſe, not only this particular place for which the meridian was drawn, but all thoſe other places which lie in the ſame ſemicircle in which it is, will alſo point directly at the ſun at the ſame moment, and in it will conſequently be noon in all theſe places at one moment, or, the mid-day of all theſe places, ſituated under the ſame meridian, is the ſame. This is plain from hence, that, if the circle were continued up to the heavens, it would, at that inſtant, paſs through the centre of the ſun, and that equally, from all thoſe places, becauſe it is the ſame circle with reſpect to all.

When we have extended the meridian of any place, or the plane of that circle which we conceive to paſs through any place, and through the poles of the earth up to the ſun, we ſhall find it eaſy to conceive all the reſt, that is, the reſult of this ſuppoſed revolution of the ſtars, called the firſt motion. We ſuppoſe the meridian of a place a circle, the plane of which is continued to the ſphere of the fixed ſtars. We ſee that this meridian, paſſing through three fixed points on the earth's ſurface, is a fixed thing, and, in the revolution of the earth round its axis, muſt be carried with it. As it therefore, in the former obſervation, (once in its revolution) is pointed directly at the ſun, ſo, being extended to the ſtarry heaven, it is once, in each revolution of the earth, alſo pointed directly at every ſtar in that heaven; the ſtar is, at that moment, ſaid to be in its meridian with reſpect to that place; and aſtronomers, though they mean this, yet, ſpeaking according to the accuſtomed forms, uſually expreſs themſelves in terms that ſay, the ſtar comes to its meridain at ſuch an hour, meaning, that the meridian, being carried round with the earth, points at that ſtar at ſuch an hour. Thus we ſee in how eaſy a manner this firſt motion, or the apparent revolution of the ſtars and ſun round about the earth, may be accounted for by the ſimple revolution of the earth itſelf about its axis. We have ſince ſeen it proved, that the earth makes an annual revolution round the ſun; and if we will only look upon a bowl that is thrown forward on a green, and ſee, that while it is making its greater journey, or running toward the place to which it is thrown, it all the while is turning ſwiftly round upon itſelf, that is, upon its own axis, we ſhall very eaſily conceive how this earth, in its great revolution, or courſe round the ſun, performs, at the ſame time, its diurnal revolution about its own axis, in conſequence of which the ſun and ſtars riſe and ſet, and day and night are made. Although it might not occur at firſt to the antients, that the earth had any motion, becauſe living themſelves upon it, and ſeeing all things move with it, they could have no ſenſe of its having ſuch motion, yet, when the ſuſpicion was once ſtarted, nothing could appear ſo natural, nor any thing ſo reaſonable.

A man in a ſhip, carried along by a briſk gale in a direction parallel to a ſhore at no great diſtance, while he keeps his eye upon the deck, the maſt, the ſails, or any thing about him in the ſhip, that is to ſay, while he ſees nothing but ſome part of the veſſel on board of which he is, and conſequently every part of which moves with him, although that ſhip goes on ever ſo ſwiftly, will not perceive that

that it moves at all. Let him, after this, look to the ſhore, and he will ſee the houſes, trees, and hills run from him, a direction contrary to the motion of the veſſel; and ſuppoſing him informed by no former opinion, it will be natural for him to imagine that the apparent motion of all theſe things is real. In a ſituation like to this we may conceive the inhabitants of the earth, who, in early times, knowing nothing of the true ſtructure or laws of the univerſe, ſaw the ſun, the ſtars, and planets riſe and ſet, and perform an apparent revolution about the earth. They had no conception that the earth moved, and therefore all this appearance ſeemed reality. But, in the eye of reaſon, if the man in the veſſel had but the ſlighteſt hint, we muſt expect him to give into the ſuſpicion: it would be plain that if the veſſel, in which he was, which was a little thing in reſpect of the trees, houſes, hills, and all the ſhore he ſaw beſide him, moved in a direction contrary to that in which they ſeemed to move, the appearance would be the ſame as if they really moved; and when the doubt was once propoſed to him, he would think it much more likely that ſo little a thing as the ſhip, in which he was, ſhould move, than that all that part of the earth ſhould; and he would begin to form a new opinion.

In the ſame manner, an idea could be no ſooner formed of the extent and greatneſs of the univerſe with reſpect to this earth, nor could a conception any ſooner enter into men's heads, that all they ſaw as the effect of the motion of all the heavenly bodies might be produced by its motion, than they would conclude it much more probable that the earth ſhould move, than that all the fabrick of the heavens ſhould; and, in conſequence, although this doctrine of the firſt motion being an effect of the primum mobile, might be received while nothing was ſtarted otherwiſe, and the whole ſtarry heavens might be then ſuppoſed to be impelled round this earth, yet no ſooner would it be propoſed, that a motion of the earth upon itſelf, a motion which they might allow it, without ſuppoſing it changed place at all, could effect all the ſame appearances, than they would be led to embrace it, and ſo to account for the firſt motion on more rational principles than thoſe of appearance.

MOUNTAINS, *in the Moon*. Aſtronomers have given the names of mountains to thoſe parts of the moon's ſurface which are conſiderably elevated above the general level. Theſe are very numerous, and the obſervation of them is one of the moſt pleaſing that the teleſcope affords.

A very powerful teleſcope is not neceſſary for this purpoſe. Indeed the view is much more pleaſing when a larger part of the moon's diſk is taken in at a time than can be by thoſe inſtruments which magnify a great deal. Another circumſtance is alſo proper to be obſerved, to ſet thoſe, who are not much accuſtomed to theſe things, right as to ſeeing them to advantage. It is a common error to chuſe a full moon for the time of the examination; but this is, of all times, the worſt that can be choſen: for the way we diſtinguiſh the elevations, or mountains, if they are ſo called, in the moon, is by the ſhadows which they project from them, but theſe ſhadows are quite obliterated in the time of the full-moon, the light of the ſun at that time falling full upon the ſurface, whereas it muſt come obliquely, in order to the cauſing of thoſe ſhadows. Nor is this all the diſadvantage, we not only cannot ſee the mountains which there really are on the ſurface of the moon at this time, but we take thoſe things for mountains which are not ſo. Thoſe ſpots on the moon's diſk, which are called after the names of Tycho, Copernicus,

and Kepler, have a brightneſs that makes them ſeem elevated above the ſurface at this time, and it is natural to take them for mountains while we over-look thoſe parts that really are elevated. Theſe ſpots are only harder, or ſmoother parts of the globe of the moon than the reſt; for when the moon gets into her decreaſe, and the mountains are diſcovered by their ſhadows, theſe ſpots caſt no ſhadows at all, but, by degrees, grow more and more faint. The full-moon is a pleaſing ſight through the teleſcope, and has great variety of luſtre and of colour, but it is not the face, on which to diſcover theſe mountains. They are beſt ſeen in the encreaſe or decreaſe, and at thoſe times (beſide the evidence we have of their being truly what they appear from their ſhadows) we ſee others in the very part of the moon not enlightned; their tops catching the rays of the ſun before they reach that part of the ſurface on which their bottoms are placed. Theſe appear like little ſtars in the dark part of the moon, and have a very pleaſing effect.

Aſtronomers talk alſo of water in the moon; but what they mean by it cannot be water; it is probable there is no ſuch fluid in the moon; the dark places they expreſs by this name are, more probably, immenſe tracts of foreſt, or ſome other thing abſorbing the light, not reflecting it, as water.

We are told alſo of mountains in Venus like to thoſe in the moon, and it is certain that there are ſuch, but they require glaſſes of a more powerful kind to view them, and an accuſtomed eye as well as a favourable ſeaſon. They may be diſtinguiſhed very clearly here in England by thoſe who take the proper opportunity; but the greateſt diſcoveries concerning them have been made in Italy, where the air is clear, and much more favourable for ſuch obſervations.

MOZENAIM. A name by which ſome, who are fond of hard words, call the conſtellation Libra; it is the Hebrew name of that ſign. The Arabs call it Mizan.

MUGAMZAH. A name by which ſome, who are fond of uncommon words, have called the conſtellation Ara, the Altar. It is one of the old Arabic names. Thoſe writers call it frequently Al Mugamzah, and from this term is made that ſtrange name Almegrameth, by which we find the Altar called upon ſome globes.

MUIA. A name by which ſome, who are fond of uncommon words, call one of the new-formed conſtellations of the ſouthern hemiſphere, the Bee, or Fly.

MULE. One of the Arabian conſtellations; it is the figure they place for Auriga, and they have contrived the bridle ſo as to take in ſome ſtars, in which, as well as in the general figure, they differ from the Greeks. They have alſo, upon their globes, another mule capariſoned in the ſame manner, and carrying two barrels of water. This latter figure ſtands in the place of Aquarius. Their religion did not allow them to draw the likeneſs of any human figure, and they have put theſe alterations in their ſpheres.

MULIER SEDIS. An affected name by which ſome call the conſtellation Caſſiopeia; it is a tranſlation of one of the Greek names of it; they call it the woman in her ſeat.

MULTAHAB. A name by which ſome, who are fond of uncommon words, have called the conſtellation Cepheus; it is the

Arabic

Arabic name of that ſign, and, in its proper ſignification, expreſſes fiery, or inflamed. There is ſomething ſingular in this, as it agrees with the Hebrew denomination in expreſſing this character; for they called it by a name that expreſſed the miſtreſs of fire, making it female: the term in that language is Baalath Halab, which expreſſes domina flammæ, and from this is that name formed, by which our aſtrologers often call the conſtellation Baalath.

MUMSIK. A name given by ſome, who are fond of hard words, but do not care to be at the trouble of underſtanding them, to the conſtellation Auriga; it is a part of one of its Arabic names; the whole is Mumſikal Ainna, and the ſenſe of it is one holding the reins. The conſtellation has been called by a name, expreſſing this ſenſe among all people. The Hebrews call it Ha Roah, Schohido Ha Reſan, that is, the ſhepherd holding the bridle, and ſo the Greeks and Latins.

MUNDUS. There is ſome confuſion between the ſeveral old authors with reſpect to the ſenſe of this word, and till we underſtand exactly what they mean by it, it will be difficult to determine concerning ſome of their opinions about it; though there are others, ſuch as its eternity, and ſelf-agency, which we ſhall equally explode in whatſoever ſenſe we take the word. It is plain, that ſome of them mean by it only this earth which we inhabit, and others extend it to the whole frame of the univerſe, including the ſun, ſtars, and all that is viſible in the heavens.

Among thoſe who limited the term, and meant by it only this earth, the greater part gave into the opinion of its being uncreated and incorruptible. Xenophanes is one of the names we find quoted, with great reſpect, on this occaſion, and we are told his doctrine was, in expreſs words, that the earth was from all eternity, and was to continue for ever, that is, it was uncreated, ungenerated, and incorruptible. Ariſtotle, and a multitude of the great names of antiquity ſubſcribed to this opinion; and Pliny, who never failed to adopt every abſurd ſentiment he found, and who ſeldom failed to ſtretch them a little farther than their authors had done, ſays, that it is rational to believe that the earth is a deity eternal and immenſe, and that it was never created, nor is ever to periſh.

Some among them who were willing to allow the earth and elements not to have been at all times in the condition in which they are at preſent, yet are not for allowing a creative power, but reſolve the whole of them into ſome one which they believe to be eternal, and ſo to have formed the reſt by different modifications of itſelf. They made fire this univerſal principle, and ſuppoſing it to be uncreated, they referred all the reſt to it, as different modifications of it. Thus the firſt doctrine was, that all things conſiſt of fire, and all things are at laſt reſolved into it again; from this they advanced, that all things changed their appearance according to circumſtances, and that condenſation and rarefaction, did almoſt the whole matter. They ſaid, that fire, when condenſed, became moiſt and cool, and was air; that air, when farther condenſed, became water, and water, yet more condenſed, was earth, and that in the end, when things aſſumed their original forms again, we ſhould find that earth, when it became diffuſed, was water, that water diffuſed was air, and air, ſet at liberty from its compreſſion, was fire; ſo that nothing was created or periſhed, but that the world being eternal, and every thing about it eternal, things ſhifted form and place, but continued for ever. Such

were

were the doctrines even of the wisest among these wise people, and from this we may see how much knowledge and religion are connected together. We have arrived at a more complete acquaintance with the laws of nature, and the system of the universe, and it gives us a new reverence for its author.

MUSATOR. A name by which some have called the constellation Sagitta, the Arrow; it is a very well established Latin name, for we find it used by Cicero, and other classics.

MUSCA, *the Fly*. One of the constellations of the southern hemisphere; it is an extremely small one, and contains only four stars. It is one of those which the late astronomers have added to the forty-eight old ones, and is situated between the hinder feet of the Centaur, and the head of the Chamelion; it is called also the Bee. *See the article* APIS.

MYRTILUS. A name by which some of the old writers have called the constellation Auriga. The Greeks, eager to adopt

M Y

some part of their fabulous history to all the constellations, at first, from the bridle in the hands of this constellation, the figure of which they had received from the Egyptians, called it by the name of Erichthonius, the son of Vulcan, whom they called the inventor of coaches; but here was an absurdity. Their story told them, that Erichthonius had legs like a serpent, and therefore invented his coach to hide them; there were no such legs to the figure they had received, nor could they add them without confounding the constellation with that of Taurus, over which it stands. They therefore afterwards gave up this history, and called it Myrtilus, whom they understood to be the son of Mercury, and charioteer to Ænomaus, and whose father, after his death, they say, carried him up, bridle and all, into the skies. This, however, gives no account of the goat and two kids in the constellation. The Egyptians only meant a countryman taking care of his flock. *See* AURIGA.

MYSTICK ROSE. A name given by Schiller to the constellation Equuleus.

N.

N.

NAAMAN. A name by which ſome fantaſtical writers have called the conſtellation Aquarius, one of the twelve ſigns of the zodiac. There have been a ſet of people who were deſirous of referring every figure in the heavens to ſome part of the hiſtory of the Old or New Teſtament. As ſome have called this Naaman, others have called it St. Jude.

NABASH BARIH. One of the ſcripture names of the conſtellations. It occurs in Job, when ſpeaking of God, the author, after ſaying, that his ſpirit beautifies the ſkies; adds, and his hand hath formed the crooked ſerpent. There have been commentators dull enough to ſuppoſe, that by this was meant the ſerpent of our fields, but this would have been a ſtrange and an unnatural leap; and it is plain, that, ſpeaking of the heavens, and ſpeaking of them under the term of ornamenting and beautifying, he means, when he adds the name of the crooked ſerpent, the conſtellation. There are ſome who have ſuppoſed the zodiac intended by the word, and others have thought the Milky Way; this opinion indeed has had many advocates; but it is yet unnatural. The Milky Way is not like a ſerpent, but has been always called by names, expreſſing a ſea, or a path way, and never by any one that had relation to an animal. It is evident, that the author of the book of Job was acquainted with the conſtellations from the names Orion and the Pleiades. It is evident, that the dragon, or ſerpent, near the north pole, was a conſtellation well known in early times; nay it was called a ſnake. We find the old poets talking of it among the conſtellations that were obſerved by huſbandmen and ſailors; and that under the name of Lucidus Anguis. When the author was ſpeaking of the heavens, he added, very naturally, the ornamenting of them, and he would as naturally ſay, how that was done, he formed the heavens, and he adorned them with the conſtellations. Inſtead of naming all the conſtellations, whoever knows any thing of the Hebrew language, will know it was very natural the author ſhould name only one of them; and what could be ſo likely to obtain that preference as one of thoſe which was in common uſe among the people who occupied the land. He ſays undoubtedly, his ſpirit beautified the ſkies, and his hand formed the crooked ſerpent, that conſtellation which ornaments the northern ſkies, and which points out to you the ſeaſons and times which you obſerve. We know that the Dragon was always figured as a crooked ſerpent, and Nabaſh Bariſh is certainly Draco.

NAHR. A name by which ſome, who love uncommon words, have called the conſtellation Eridanus; it is one of its old Arabic

Arabic names. The word only ſignifies a river.

NAIR PHECCA. A name given by ſome to one of the bright ſtars in the Corona Borealis; that diſtinguiſhed by the name of Lucida Coronæ; it is an Arabic name of the ſame ſtar.

NANO. A name by which ſome, who are fond of uncommon words, have called the conſtellation Piſces; it is the Syrian name of the ſign, and ſignifies a fiſh.

NAVIS. One of the forty-eight old conſtellations mentioned by all the writers on aſtronomy, and of very conſiderable extent in the heavens. There is hardly any one of the conſtellations which occupies a larger ſpace in the hemiſphere, but there are many which compriſe a greater quantity of ſtars; and what is more remarkable is, that in all this extent there are none very conſiderable in their ſize or luſtre. It is repreſented in the ſchemes of the heavens with maſts and ſails, and a large and full body, its place is in the ſouthern hemiſphere, and the bottom of its hull comes within a moderate diſtance of the ſouth pole, although its maſts reach up to the hinder legs of the Unicorn. The figure is uſually tolerably well drawn, at leaſt it has nothing of that monſtroſity and ſtrangeneſs which is in many of the images of the conſtellations, and the ſtars, though not very numerous, are diſpoſed in a happy manner, to mark ſeveral of its principal parts from the names of which they may be ſpoken of with convenience. The conſtellations, between and among which the Ship is ſituated, are the Royal Oak, the Centaur, the Hydra, the Unicorn, and the Great Dog. The Royal Oak is under its bottom, the Centaur is at a diſtance from one end, the Hydra is at a greater diſtance, but runs parallel, or nearly ſo with the maſts, and the Dog is on the oppoſite ſide toward the ſtern, and much nearer.

The old aſtronomers allowed forty-five ſtars to this conſtellation, a number, though in itſelf conſiderable, yet very moderate in proportion to the ſpace occupied by the figure. Ptolemy ſets down this number, therefore this was the account of Hipparchus, and all the old aſtronomers have followed him in it. Flamſtead makes them ſixty-four; but neither is this number at all ſuited to the extent. Aquarius is a much ſmaller figure, and it compriſes more than an hundred.

Of theſe there is not one of the firſt, nor one of the ſecond magnitude, but there are two of the third magnitude, and three more, which ſome will have of this claſs, though others refer them to the fourth, one of the allowed thirds is in the ſtern in the lower, and the other in the upper part, and a third of theſe, the firſt of the diſputed ones, is in the middle of the ſtern, another in the yard, and the third between the ſail and hull, there are ſome of the fourth magnitude, but more yet of the fifth, and of the ſixth more than all. Theſe are diſtributed about the figure, though in an irregular, yet in an uſeful manner; there are ſeveral in the body, ſome on the maſts, and a pretty cluſter in the ſail.

The Greeks, who are for having aſtronomy owe its riſe, as well as improvement to them, affix parts of their hiſtory, or fable, to every conſtellation. They tell us, this was the famous ſhip in which the Argonauts made that celebrated expedition, which has been ſo famous in all their hiſtory. Sir Iſaac Newton is for referring the origin of many of the conſtellations to that period; it is certain, none of them refer to any thing later, but many

many of them to things much earlier. That the uſe of the conſtellations was as early as that of navigation is certain; for people would never have ventured to looſe ſight of land till they had got ſome fixed point, which could only be in the heavens, by which to direct their courſe. This will let us know, that the formation of the conſtellation was as early as navigation, but there is nothing to inform us, that it was not earlier. We find Diodorus Siculus mentioning the uſe made by the Arabians of the Two Bears in the heavens, which they obſerved as regularly in travelling over the vaſt deſarts of that country, as ſailors in guiding themſelves at ſea. We have no cauſe to doubt but that land-travelling was much earlier than that by ſea; and we find the uſe of theſe conſtellations very plainly mentioned, as well as ſpecified, by a peculiar denunciation, as early as the prophet Iſaiah. The ſtars of heaven, and its *Cheſils*, that is the Hebrew word, ſhall not ſhine bright; this is a threatning to the Babylonians; the word is plural, but it is the ſame that is uſed in the ſingular in the book of Job, and is there tranſlated by Orion; there is no reaſon to doubt but that it means the Great Bear, or Wain: and if we ſuppoſe both the Bears, or both the Wains, known in thoſe times, the uſe of the plural number is eaſily accounted for, and this, though it would have been of no ſuch vaſt importance to them, if ſpoken of any other of the fixed ſtars, yet was of the greateſt when ſpoken of theſe, which were their guides and directors in their land-travels, as well as voyages at ſea, if they made ſuch. We ſee all this among the things unknown to the Greeks. Nothing can be ſo idle as that people's aſſuming to themſelves the honour of inventing things which were in uſe ages before they were a people, and which we know to have been familiarly mentioned by authors, who wrote before the time of that Thales, who is confeſſed to have brought the knowledge of the conſtellations into Greece.

NEBULOSE STARS. Among the fixed ſtars there appear here and there ſome, which vary in a great degree from the characters and appearance of the reſt. It is an obſervation, and a very juſt one, that the fixed ſtars may be known from the planets by the radiance and brilliancy of their light; they twinkle, and, to the eye, have not the ſteady and equal appearance of the others. The fixed ſtars, in general, have this peculiar brightneſs, but what are called nebuloſe ſtars are an exception to the rule; far from having more brightneſs than the planets, they have leſs than any other of the heavenly bodies. Theſe nebuloſe ſtars appear to the naked eye not, as the others, bright and ſhining, but, as the term expreſſes, in form of a kind of fine cloud; they look like the Milky Way in the heavens, only that they have ſo little extent. They exhibit a kind of whiteneſs, or general illumination, in the places where they are without any determinate figure. When the teleſcope is applied to theſe, it finds them of two kinds, or at leaſt different greatly in degree; but by the explanation which it gives of the one, it leaves no room to doubt the true ſtate of the other, ſome of them, when obſerved, through glaſſes of proper power, are found to be cluſters of extremely minute fixed ſtars, diſtinct and diſtant from one another; theſe are very remote from the earth, and though we ſhould not, with the unaſſiſted eye, diſtinguiſh them ſingly, their blended luſtre, when they come to be ſo near to one another, gives this appearance of a luminous ſpace; theſe are therefore eaſily to be underſtood, but the others will not be ſo diſtinguiſhed, even by

by the beſt inſtruments we are yet poſſeſſed of. Our moſt powerful teleſcopes only extend their ſurface, and make the lucid ſpeck larger, but ſhew no diſtinct points of light in them.

There is ſomething very extraordinary in the latter kind of nebuloſe ſtars. The famous one in the conſtellation Andromeda, diſcovered in 1612, is a remarkable one of this kind; this was firſt obſerved by Simon Marius; it is ſituated near the moſt northern ſtar of the girdle. To the naked eye, it appeared to him like a little bright white cloud; when he applied a teleſcope to it he did not diſtinguiſh, as might be expected, a number of diſtinct ſpecks of light, or little ſtars. The ſpace, or magnitude of the lucid appearance was augmented, and he found it full of bright and white rays, which were more and more bright, as they approached more to the centre; its diameter was about fifteen minutes, and it had, in many reſpects, greatly the appearance of the comet ſeen by Tycho in 1586. Marius heſitated whether he ſhould call it a new ſtar, or not; but he was ſurpriſed to find ſo remarkable an appearance not at all mentioned by Tycho, who had been ſo careful in his view of the very part of the heavens where it was, and had aſcertained the place of the northern ſtar in the Girdle.

This nebuloſe ſtar was loſt for ſome conſiderable time; but Bouilland ſaw it in its true place again in 1664; and doing juſtice to the obſervations of Marius, he declared it his opinion, that, like the re-apparent, or changeable ſtars, it ſometimes diſappeared, and ſometimes was in ſight, therefore Tycho might eaſily want an opportunity of deſcribing it, as it might not appear during the time he was obſerving that part of the heavens. What the more favoured this conjecture was, that this nebuloſe ſtar is put down in the catalogues of ſtars, publiſhed ſo early as in 1500, and yet that neither Tycho nor Bayer ſaw it afterwards. Fom the time of his firſt appearance, noted down in 1500, no one appears to have ſeen it till Marius, one hundred and twelve years afterwards, and from his time none till Bouilland, fifty-two years after that. Bouilland publiſhed his obſervations about two years after he firſt ſaw it, and he adds, that it had, though at that time viſible, been decreaſing in brightneſs ever ſince its firſt appearance. We are, however, to look upon theſe accounts as coming from men liable to err, and moſt likely to do ſo when they have any favourite ſyſtem to advance. Bouilland wanted to make this a re-apparent ſtar, and conſequently he fancied that, from its firſt appearance, it had been looſing its brightneſs; as to the loſs of it in the heavens, in the intervals of which authors are ſilent about it; their ſilence is no proof of any ſuch loſs. Tycho and Bayer might ſee it, and not allow it to be a ſtar, This is certain, that it has kept its place and figure in the heavens, ever ſince the time of Bouilland, and does ſo ſtill, without any encreaſe or diminution of magnitude, or luſtre, ſo far as can be judged from what has, from time to time, been written of it in this period. Its figure is nearly triangular, and it is at this time very conſpicuous, and of a ſingular appearance.

The nebuloſe ſtar in Orion, which is alſo one of the moſt ſpoken of, was diſcovered by Huygens in 1656; it is in the ſword of Orion. This, when viewed through a teleſcope, is ſeen to be a ſpeck of bright light in the heavens, of a parallelogram, as the other of a triangular figure, but it is one of the nebuloſe ſtars, of the firſt, or ordinary kind; for if the glaſſes be of ſufficient power, it is ſeen to conſiſt of a great number of points of light diſtinct from one another: theſe are ſo many

fixed

fixed ſtars, which, although not viſible ſingly, without ſuch an aſſiſtance, yet together form a brightneſs with their blended light, that is perceptible at the earth's diſtance. The parallelogram formed by this nebuloſe ſtar, is irregular, and there is yet more in it than is diſcovered even by the beſt teleſcopes. It is true, that we ſee certain fixed ſtars in it, but there are not enough of them, nor are they conſiderable enough to give all that brightneſs to the ſpace, taken up by this appearance. This ſeems therefore, though truly of the firſt kind of nebuloſe ſtars, ſo far as to be ſeen, furniſhed with little diſtinct and diſtant points of light, yet, in ſome degree alſo of the ſecond, ſince there is a light in it that muſt have another origin in part, as that of the triangular one in Andromeda has altogether, no lucid point, or fixed ſtar, being ſeen in that diffuſion of brightneſs.

There is another nebulous ſtar near the head of Sagittary, much ſpoken of by aſtronomers; this was firſt diſcovered by Araham Ihle in 1665; but there is doubt whether the expreſſion ſhould not be changed in regard to Ihle. Kirkius ſays, he diſcovered it, and others have followed him; it is certain, he firſt named it, but there is ſome appearance that it had been ſeen before.

A fourth of the nebulous ſtars is that which Kirkius himſelf firſt diſcovered in 1681; this is near the north foot of Ganymede. The figure was, according to his account, very like that of the comet ſeen in 1610; this is ſo ſmall that it does not appear to the naked eye, but a very ordinary magnifying power will ſerve to diſcover it. A four-foot refracting teleſcope ſhews it diſtinctly among the ſeveral informed ſtars that are about that conſtellation.

Theſe nebuloſe ſtars have greatly perplexed ſome aſtronomers; but it ſeems eaſy to account for them, and, as was obſerved before, the firſt or ordinary kind, which are perfectly well underſtood, will ſerve to explain the others. We ſee theſe by the naked eye as ſo many lucid ſpecks in the heavens, as ſpaces of diffuſed light, the origin of which we know not. On directing a teleſcope to theſe, the myſtery is explained, for we ſee them compoſed of a multitude of fixed ſtars, at ſome diſtance from one another. As to the other kind, they are doubtleſs compoſed of the ſame points of light, or have cluſters of ſtars for their origin, but ſome of theſe are ſo remote, that the teleſcopes we have at preſent in uſe, have no more power over them than our eye over the others. Some of theſe are, as nebuloſe ſtars, to be ſeen only by means of teleſcopes, can it then be a wonder, that the ſtars which compoſe them, ſhould not be diſtinguiſhable even by thoſe teleſcopes? The regions of ſpace are unbounded, and we have reaſon to believe ſtars are placed throughout; if ſo the very remote, which are not diſtinguiſhable to the teleſcope ſingly, may appear to it when they form theſe cluſters; this is evidently the caſe with the ordinary kind, and there is no room to doubt it is ſo of the others, only that theſe ſtars are vaſtly more remote. Beſide the four nebulous ſtars, juſt mentioned, there is one in the Crab, and another in the head of Sagittary, but ſmaller than that near it, and one between the Great and Little Dog.

NECKAR. A name by which ſome, who love uncommon words, call the conſtellation Bootes; it is one of the Arabic names of the conſtellation, and ſignifies an huſbandman.

NEGIM, *or* Al Negim. A name by which ſome, who love hard words, have called the Pleiades; it is the Arabic name for that conſtellation. The proper ſenſe of the word

is the ſtar, or the conſtellation, they called the Pleiades ſo by way of eminence; as they were regarded in an uncommon manner as preſages of the rains which give the earth's increaſe, and were underſtood to be the new year's ſtars, the antients counting the year from the time of their riſing. From this alſo aroſe the cuſtom of calling all the other conſtellations the children of the Pleiades. The word, in the Septuagint, rendered Arcturus, in the original ſignifies this cluſter of ſtars, and this is the origin of the expreſſion, which the inſpired writer makes uſe of on the occaſion, "Guide "the Pleiades and its ſons.

NEMESIOS ASTER, *The Star of Nemeſis*. One of the Greek names of the planet Saturn.

NEPA. A name by which ſome of the old writers call the conſtellation Cancer.

NESCHER. A name by which thoſe, who are fond of hard words, call the conſtellation Aquila; it is the Hebrew name of that conſtellation, and ſignifies an eagle.

NEW STARS. What are called the new ſtars offer a phœnomenon more ſurpriſing, and leſs explicated, than almoſt any thing in the whole courſe of the ſcience. That there have, at certain times, appeared ſtars in the parts of the heavens in which there were none before, and they have gradually diſappeared again, and their places are now as vacant as they were before, is certain, nor is it leſs ſtrange than certain. This is very obvious; but there are other appearances relating to the fixed ſtars, which, although leſs obvious, are very ſingular, and which tend the ſame way.

We ſee, in many parts of the heavens at this time, ſtars, which, although large enough for the view, are not mentioned by the antients, who named the reſt with ſufficient accuracy. We are not to condemn thoſe authors on that account, till we have conſidered all circumſtances: there are others, the ſituation and preciſe place of which has been marked heretofore, and which we do not ſee at preſent. Finally, there are others which have, and do, from time to time, augment and diminiſh in point of bigneſs and apparent diameter; appearing much larger and brighter at ſome times than at others, and which, after having entirely diſappeared, do, at a diſtance of time, become again viſible, and afford, in ſucceſſion, all theſe variety of appearances. In order to the conſidering one of theſe phœnomena, we ought to be informed of the reſt, for they tend to explain one another.

With regard to thoſe ſtars which we ſee and inſert in their places at preſent, and which have not been named in the catalogues of the antient writers, nor ſet down in the figures they made of the conſtellations, we are not to ſuppoſe that they were all of them inviſible at that time, and have appeared in the heavens only ſince; this would be to encreaſe the number of ſtars at a ſtrange rate, and at a very unfair one. We have opportunities of examining the heavens, which they wanted, and perhaps we have a yet greater accuracy; at leaſt, having the uſe of all they knew, we have the better opportunities of going farther. Moſt of theſe ſtars which we have ſet down, and of which they took account, are ſmall, and might be overlooked.

A great deal of confuſion has been let in on this account. Not to ſay any thing of the uſe of glaſſes, which are modern, the natural ſight in ſome men is very ſtrong, and in others weak conſequently; and it has proved ſo in fact. Some men will diſtinguiſh certain ſtars, which

which others do not nor can fee. Such ftars as have been in this manner feen by fome, and not feen by others, who have treated of them at diftant periods, have, by rafh and hafty judges, been fuppofed to appear and difappear at times; and thus ftars, becaufe they are not very eafily vifible, have been added to the account of new ones; but thofe of which we abfolutely fpeak as new ftars, or as fuch as really do appear and difappear at times, are large enough for all eyes to fee, and their place fufficiently marked. To avoid any error, it may be proper to give an inftance of one of thefe fuppofed new or re-apparent ftars; for example:

The Pleiades have been called feven ftars, but in general there are feen only fix, that is to fay, in proper terms, there appear only fix to the generality of people. Let us examine this matter according to the teftimony of antiquity, and we fhall fee an inftance of this error very evidently. All men have diftinguifhed as many as fix, and a feventh has been fpoken of by fome. This feventh has therefore the character of a re-apparent, or new ftar. It is faid that it appeared before the deftruction of Troy, and that they were then feven; after which event, they fay, it was loft for many ages, and at length re-appeared in its place again; and to this many have referred the difputes on the fubject of the Pleiades, whether they were fix ftars or feven, and have determined on neither fide. However, Attalus and Geminus counted only fix ftars in the Pleiades, but then we find that Simonides, Varro, Pliny, Aratus, Hipparchus, and Ptolemy, have all mentioned feven, and the generality of aftronomers have followed them, and called the ftars, univerfally, feven. We are to conclude from this, what appears even at this day on infpection, not that a feventh ftar has appeared and difappeared at times, but that fix being large, and very vifible, all men have been able to fee and count them, and, the feventh being fmall, no one has been able to fee it but the few who have had very good eyes, or eyes adapted to fuch objects. In effect, we find the generality of mankind, at this time, mentioning only fix, and feeing no more, but here and there a man diftinguifhes feven. As to the real number of ftars in that conftellation, it is much greater. It has been obferved, that telefcopes diftinguifh ftars in all parts of the heavens, and they do this as well in the conftellations as out of them. Galileo, foon after the improvement which he made in thefe inftruments, put forth his *Nuncius Sidereus*, in which he mentions thirty-fix ftars of which this conftellation was feen to confift, by means of the glaffes he ufed. He has given the place and fituation of thefe in a figure, and that very juftly; he fays, in general, that he could fometimes fee forty ftars in this conftellation by the help of glaffes, befide thofe obvious to the naked eye; thefe he calls fix, the feventh, he fays, being very rarely vifible.

From the time of Galileo to this, telefcopes have been more and more improved, and confequently greater and greater difcoveries made as to the number of ftars in the conftellations. De La Hire, of the French academy, about fixty years ago, having occafion to mention this conftellation, on occafion of the paffage of the moon through it, gives an account of fixty-four ftars, which he, at that time, difcovered in it. Among thefe, befide the feven mentioned by many of the antients, he allows the two named by Longrenus, the Atlas, and the Mater Pleione. He is very accurate alfo as to their places, and gives way to a fufpicion, from his obfervations not perfectly agreeing with thofe of Riccioli on this head, that the fixed ftars do not always keep the fame place

with

with regard to one another. Maraldi, fifteen years afterward, took great pains about the same constellation; he puts down only fifty-six indeed (eight less than De La Hire) and there is some difference between him and the other as to their position; but this, as well as the other, is to be referred to the great difficulty of being exact on these occasions, and not to any change of place in the stars themselves. Men would over-turn the system of the universe, rather than own an error.

By this instance of the Pleiades, which has been considered at large by way of example of what may have been the case with the other constellations, we see how easy it is, not only for the naked eye, but even telescopes, in the hands of the most judicious, to over-look certain stars, and that when others see them. We are not thence to conclude that they were not in the same places, because not seen before. This is of consequence, as it separates a number which have no title to the name from out of the class of what are called new stars, and takes away doubt and confusion. When under that term were comprehended all those minute stars, which, for that reason only, might be seen by some and not by others, the whole might appear uncertain and indeterminate; but when we confine the term, and express nothing by the name of a new star, but such as has appeared at certain times, and disappeared at others, and whose appearance was conspicuous, the bigness and brightness of which have rendered it at once conspicuous to all persons, and which has been seen to fade and grow less gradually till it disappeared, we shall rescue the term from obscurity, and limit it to the expressing something very certain, and very surprising.

Men have, in all times, given an account of what they called new stars, and those which are mentioned by the old writers, are of this conspicuous kind, but still some of them are to be excluded. To reduce the matter to a certainty, we shall place no great dependence upon the accounts of those new stars mentioned by such writers among the antients as did not make astronomy their study, since they have not ascertained their places, nor is it possible to distinguish, by what they have said, whether those, of which they speak, were fixed stars or comets. Without knowledge and precision, history is blind and useless. Of this set is that which Pliny mentions as having been observed by Hipparchus an hundred and twenty-five years before the birth of Christ. In this list of the uncertain, we shall also place a second, which is said to have appeared in the time of the Emperor Hadrian. A third of this class is that which Cuspinianus discovered in the year three hundred and eighty-nine, in the Eagle. This, Licetus says, was, at its first appearance as bright as Venus, and that, after having been seen three weeks, it disappeared. Authors speak of a new star seen in the year 388 or 389, in the time of Honorius. This was, undoubtedly, the same with that of Cuspinianus. A fourth we read of, seen by Messahala, Haly, and Albumazar, at fifteen degrees of Scorpio. This, they tell us, appeared for four months, and was so bright that its light was reckoned equal to that of a fourth part of the moon. A fifth is mentioned by Cyprianus Leonitius, discovered in the year 945, in the time of Otho, its place between Cassiopeia and Cepheus. And a sixth, which, according to the same author, appeared in 1264, near in the same part of the heavens. There is no doubt of there having been appearances to give origin to these observations, but the circumstances, necessary to have been added to the accounts of them, are wanting, and there is no speaking any thing of certainty concerning them. But it is much otherwise with

with regard to those observations that have been made since the late improvements in astronomy; of these we can speak with certainty.

To begin with the earliest of the accounts that can be comprised within these bounds, we are to mention the new star which was seen in the constellation Cassiopeia in the year 1522. This was at a time when astronomy was sufficiently cultivated to give the account with precision, and of this we can judge. This appeared at once in the beginning of November that year, and remained sixteen months visible. In all this time it kept its place in the heavens without the least variation; it made a triangle with the three first stars of that constellation, and, in all the time of its appearance, it never had the least change of place. This star had nothing of that hairy radiation which has been observed about certain comets, nor did it, in any thing, resemble them. The light of a comet is more placid and steady, as well as more faint, than that of a planet; but the light of this star was distinct from both, it had the genuine distinction and true radiancy of a fixed star, it twinkled in the manner of the fixed stars, and was, in all things, like to Sirius, the largest and brightest star in the heavens, except that it was larger and brighter. In this there could be no error, every eye saw so conspicuous a star in a place where none such appeared before, and the astronomers found it never to change place, so that, to the distinguishing light of the fixed stars, it had their fixed station; this, therefore, was undoubtedly a fixed star, and as undoubtedly a new one. Jupiter approached it in his perigee, and it appeared larger than Jupiter, and next in size to Venus. It did not, by degrees, acquire this diameter, it appeared at once in the heavens in its full bigness and brightness, as if it had just then been created of that size. It continued about three weeks in its full and entire splendor, and, during that time, might be seen through thin clouds, and, by those, who knew where to look for it, and had good eyes, it was seen all day; before it had been seen a month it became visibly smaller in diameter, it was reduced to about the diameter of Jupiter. In January it was something smaller than Jupiter, but still larger and brighter than Sirius; in February and March it appeared altogether like the fixed stars of the first magnitude in size, and in brightness; in May it was reduced to a star of the second magnitude, and in July it appeared of the same size with the largest in the constellation of Cassiopeia, which are of the third magnitude; in October it was a star of the fourth magnitude; in the January 1579 it was no larger than a star of the fifth magnitude; in February it was no more conspicuous than a star of the sixth magnitude, and from this time it continued diminishing in magnitude and brightness till March, when it entirely disappeared.

The brightness of this star diminished with its apparent diameter; nor was this all, the very colour of its light also differed; at first its light was white and extremely bright and sparkling. From this time, as the star diminished in bigness, the light became yellowish, and, in January and February, 1573, it was of the colour of Mars; it resembled Aldebaran, and was somewhat less bright than the star in the shoulder of Orion. After this, it had the pale whitish colour of Saturn, which it retained to the end of its appearing, but that it grew fainter and fainter to the last. In all this time, however, it preserved that twinkling which is peculiar to the fixed stars, and which, although it diminished with its lustre and magnitude, it never wholly lost to the last of its appearance.

We

We can have no doubt about the truth of this, the ſtar was ſeen by many good aſtronomers; but it is enough to ſay, that the accurate Tycho Brahe perceived it on the eleventh of November, and continued to obſerve it to the laſt; he began an account of it under the title of *De nova Stella*, and has done it with great accuracy and fidelity. He determined its longitude at ſix degrees, fifty-four minutes of Taurus, and its north latitude at fifty-three degrees, forty-five minutes; its right aſcention at twenty-ſix minutes, and its declination north at ſixty-one degrees, forty-ſeven minutes: he attempted to find its diſtance from the earth ſeveral ways, but having in all his obſervations found that it had no ſenſible parallax, he was convinced, that it was out of our ſyſtem, and was truly in the region of the fixed ſtars.

It was fortunate that this ſtar had a ſituation in the heavens, very favourable for obſervation, it was but at the diſtance of twenty-eight degrees, thirteen minutes from the pole, and conſequently it performed its diurnal revolution without ever being under the horizon. This gave Tycho an opportunity of obſerving its paſſage through the meridian, as well in the lower as in the upper part of its circle, and, in conſequence, he found in it that great and true characteriſtic of a fixed ſtar, that it was always at the ſame diſtance from the pole ſtar, and from the other fixed ſtars; this could not have been the caſe, had it not been that immenſe diſtance from the earth; for otherwiſe the parallax making ſtars appear below their real ſituation, he would have ſeen that ſtar approach the pole in its greateſt height, and, on the contrary, depart from it in its leaſt height; but nothing of this happened, and conſequently it was at that diſtance, and had this place, together with the other characters, to determine it truly a fixed ſtar. Riccioli has propoſed ſome doubts about Tycho's determination from this obſervation, and ſays, that all his obſervations did not prove it to be above the ſphere of the moon; but although he reaſons on geometrical principles, he errs. The obſervations of Tycho do abſolutely ſhew, that the new ſtar was at a greater diſtance from the earth than the ſun is, and all things concur to fix its true place to be, as he ſuppoſed, in the region of the fixed ſtars.

After the time of this ſtar, in the year 1604, there appeared another new one in Serpentary; this firſt appeared in the month of October, and it was ſeen in ſeveral parts of the world, remote from one another, as in Germany, Italy, and Spain. Many aſtronomers made their obſervations on it, and Kepler, in particular, publiſhed a treatiſe on the ſubject, under the title of *De nova Stella Serpentarii.*

Kepler fixes the day of the firſt appearance of this ſtar to have been the tenth of October, though Spate ſays, it was ſeen by Heraclius on the twenty-ſeventh of September; he adds, that it was preciſely round, that it had neither hair nor tail in the manner of the comets, and that it had all the brightneſs and luſtre of a fixed ſtar, twinkling as they do. He adds, that many perſons ſuppoſed its brightneſs greater than that of any other ſtar. Another ſingularity in it was, that as the colour of that in Caſſiopeia, was, at its fineſt and ſtrongeſt appearance, only a bright white, this ſtar ſucceſſively gave all the colours in the manner of a diamond; thoſe, in general, who ſaw it, agreed, that it was larger than any other fixed ſtar, or than any of the planets, except Venus. Jupiter was for a conſiderable time near to it, and appeared ſmaller. In this, and in other reſpects, the new ſtar in Serpentary perfectly agreed with the former in Caſſiopeia; it was alſo like the other in

its

its decreafe; it kept all its luftre, and its full bignefs for about three weeks, after this it grew fmaller. The aftronomers of Turin continued their obfervations on it to the twenty-third of November, at which time it was entirely hid in the beams of the fun; it was now loft till the third of January, but on that night it was feen again; it had retained its luftre in a great degree, but was diminifhed greatly in fize. It, at this time, appeared fully as large as the Cor Scorpionis, which was farther off the fun's rays. About the middle of January it was judged larger than Arcturus, but from this time it diminifhed more and more continually, till toward the end of March it was fmaller than Saturn, and hardly exceeded in fize the ftars in the knee of Serpentarius. In April it was of the fize of the bright one in the knee of Serpentarius. In Auguft it was not larger than a ftar of the third magnitude; but in all this decreafe of magnitude, it continued bright and twinkling. In September it was ftill lefs; in October it was difficult to be perceived, it approached the fun's rays fo nearly; in the January following, the morning crepufcule would not let it be feen, nor the fmall ftars about it; in February, Kepler thought he faw it, but it was uncertainly. In fine, it is not abfolutely certain how long it continued after the October, 1605, accidents were then ftrongly againft it; fo that it is not unlikely it lafted three or four month longer. In March there were favourable opportunites of looking after it, but no trace or veftage of it remained in the place where it had firft appeared, and from which, during the whole time of its appearance, it had never removed. Kepler examined it clofely, but he difcovered no motion in it, nor any fenfible parallax. Hence he judged, as in the cafe of the other, that is was more diftant than the planets, and was in the region of the fixed ftars. Moft of the aftronomers of the time concurred in this opinion of Kepler, but Scipio Claramontius declared againft it. He calculated from obfervations made by others, not by any of his own. Bleau has alfo attributed fome motion to it; he fpeaks of fome degrees according to the order of the figns; but although he mentions obfervations of his own as the foundation of this opinion, they were probably not fufficiently exact. We know what regard is due to Kepler, and we know the greateft aftronomers of his time agreed with him, that it remained all the time fixed in its place. He has given an exact defcription of the ftars about the place where it was, and affures us, that it retained the fame fituation with regard to them; fo that it is beyond doubt that it had not any motion, nor any fenfible parallax, but agreed perfectly, and in all things, with the new ftar of Caffiopeia, and in all things with the character of the fixed ftars, except in its fading away.

In the year 1576, Fabricius difcovered a new ftar in the neck of the Whale; but this being no more than equal to a ftar of the third magnitude, was lefs univerfally regarded. He firft faw it in Auguft, and it was wholly loft in the October of the fame year; fo that its duration was much fhort of the others, and feemed proportioned to its bignefs; though few, except David Fabricius, have exprefsly mentioned this collateral and very fufficient proof that it was there. Bayer publifhed his figures of the heavens in 1603, they were drawn, according to his own account, feven years before, which correfponds with the time of Fabricius's obfervation, and we find this very ftar marked in this conftellation in the place the other affigns it, as a ftar of the fourth magnitude: he had no notion of its being a new one, but there is none fuch in the place at

this

this time. He had probably seen it a month after its first appearance; for, like all the rest, it diminished gradually, both in bigness and lustre, till it was quite lost. What is yet more singular, in regard to this star, is, that in 1637, Phacylides Holwarda, who seems to have had no knowledge of Bayer's tables, saw it again, and took it for a quite new discovery. He watched the place in the heavens exactly, and he saw it appear again in the succeeding year, just nine month after its disappearance at his first observation; after this it was found every year to come in sight again very regularly, except that in 1672, it was missed by Hevelius, and not seen again till December 1676.

This was a phœnomenon so considerable in astronomy, that the studies of all the persons of knowledge of that time were employed upon it. Bouilland published an account of it at Paris in 1667, and in this, having compared, with great accuracy, the several observations made from the time of its first appearance, he computed that the period of its return, in full brightness, was three hundred and thirty-three days. He had for this purpose before him observations made from the year 1638 to 1666, so that the materials were sufficient. He found that the interval between the time of its first appearance, and its absolute disappearing was about one hundred and twenty days; and that it continued in its full lustre about fifteen days: he observes farther, and that also is very singular, that this star did not appear at once in its full magnitude, or brightness, but by degrees arrived at them; and he solves the phœnomenon, by supposing this star to be a globe, the greater part of the surface of which is obscure, and a small part luminous; he supposes, that it has a periodical revolution about its own axis, and that it presents to the earth, at some times, the dark, and, at other, the luminous part of its surface; this was, however, not an absolutely new opinion, for Riccioli had advanced it in 1651, in his second volume of the Almagest. Speaking there of what are called new stars, he says, that he takes it for granted they have been created from the beginning of the world, but that they are not like the other stars, luminous all over their surface; he supposes them to be globes, one half of whose surface is obscure, and the other luminous; but he is a little enthusiastic in his account of their shewing their bright side. He does not suppose, that they have any revolution natural to them, but he imagines, that when the Almighty has a mind to shew a sign to mankind, he turns about the bright face to us, this he imagines done instantaneously, and that therefore we see them at the first moment in their full lustre. Their dark side, he says, is naturally toward us, and that from the time of this turning them about, there is a motion of getting back to that their original situation: this, he says, is performed slowly, and therefore, that we see them loose their light not all at once, but gradually, till they quite disappear. Bouilland was wise in dropping the supernatural part of this system, but he would have been more honest to have confessed where he got the natural. All the difference between the two writers is, that the one supposes a regular revolution of the star upon its own axis; the other makes the turning about instantaneous, and the immediate work of God. They calculated their explications for their several subjects. Bouilland from the star in the Whale, which gradually encreased in bigness from its first appearance, when it was only equal to a star of the sixth magnitude, and then decreased again to nothing. Riccioli calculated from the star in Cassiopeia, and that in Serpentarius, which are said to have

have appeared at once in their full glory and greatest bigness. Might he not as reasonably have supposed, that these acquired that bigness by degrees, but that they were not observed till they became conspicuous at their full period, and so were observed by astronomers only during their decline from it? Surely there would have appeared as much probability in this, as in their appearance being owing to an immediate miracle. But be the system of Bouilland plausible, as it may, it will not hold: a simple revolution of the new star in the neck of the Whale round its own axis, would not account, for all its appearances, according to those very observations that were before him; for were there no more in it, its appearance was different in different years; in the first year in which it was observed it never exceeded the apparent bigness of a star of the third magnitude; in some other years it was seen to encrease to the size of a star of the second magnitude; in some of the succeeding appearances it was yet larger than a star of the second magnitude, and in some others it did not arrive at a bigness equal to one of the third. It appears also, by those observations, that the times of its appearance were not of equal duration, some years it continued visible four months, and in others only three: neither was it equal to itself in the time of its encrease from the first appearance to the full magnitude, nor in the period between its full lustre, and its total disappearance. These were circumstances in which those who made the observations were too careful to err, at least, to err much; and it is evident from the accounts, that it sometimes encreased much quicker than it diminished, and sometimes diminished quicker than it had encreased, so that there is no regularity; and finally, Hevelius assures us, that it never appeared at one time for four years together.

Perhaps these appearances may be better explained by attributing a particular motion to the poles of the revolution made by this star, round its own axis; this might easily make the appearance of the star to us shorter or longer, and account for many other of its variations, according to the different position of those poles, with respect to the luminous part of the star, which it occasionally presented to us in different aspects.

If, in order to determine the period of its several appearances, we compare together the first observations made concerning it in the year 1596, and all those which were made in succession afterwards, from the thirteenth of August 1596 to the first of January 1678, we shall find eighty-one years, four months, and eighteen days, that is, 29725 days, and these divided by 89, give 334, and not 333 days for each revolution. In the month of August 1723, it was observed of the same magnitude of which Fabricius determined it; equal to a fixed star of the third magnitude. We have here a period of an hundred and seven years, twenty-four of which being bissextiles, this allows, in the whole, 39080 days, which being divided by 117, give also every revolution for its period the same number, three hundred and thirty-four days; this is truly therefore the mean of its revolutions.

Since the first observation of this star, there have been discovered no less than three other changing, or re-apparent stars, in the single constellation of Cygnus. The first of these was discovered by Kepler in 1600, at the bottom of the Swan's neck, near that in the breast, which is the γ of Bayer; this does not appear in the catalogue of Tycho, although he has mentioned, with great precision, several that are near it, and smaller. Bayer has called this a new star; he names it as of the third magnitude, and says, it never

changes

changes its place. Janſon ſpeaks of it alſo as a new one, and claims the diſcovery; he ſays he firſt ſaw it in 1600. What is ſingular in this ſtar is, that, during a period of nineteen years, in which it was obſerved by Kepler, it always kept its proper and original magnitude; being not quite ſo large as that in the breaſt which was near it, nor quite ſo ſmall as that in the neck. Liceti ſaw it again in 1621, and continued to obſerve it till it grew ſo ſmall that he wholly loſt ſight of it. It was again ſeen in 1695 by the elder Caſſini; it continued, at this time, not the ſame as in Kepler's obſervations, but augmented, during five years, till it was equal to a ſtar of the third magnitude, and after this it gradually diminiſhed. Hevelius ſaw it again in 1665; in 1666 it was yet very ſmall, and though it continued encreaſing in ſize, it never arrived at the third magnitude; and in 1677 and 1692 it was no more than a ſtar of the ſixth. In the year 1715 it was ſeen in the very place where it is marked by Bayer, its bigneſs that of a ſtar of the ſixth magnitude.

The ſecond of the changeable ſtars in Cygnus was diſcovered by Antebeline Chartreux, near to the head of the Swan, in the year 1670; it appeared, at firſt, equal to a ſtar of the third magnitude, and it continued to be viſible three months, but continually diminiſhing both in bigneſs and luſtre; at the end of that time it wholly diſappeared. This ſtar is not named in any of the old catalogues of the fixed ſtars, although ſeveral that are near it, and are a great deal ſmaller, are marked with a ſufficient accuracy. It was firſt ſeen on the twentieth of June, and, like the ſtar in Caſſiopeia, was then in its full glory; in the beginning of July it began to diminiſh both in ſize and luſtre. According to the author's obſervation, its light grew faint before it began to diminiſh in ſize; he obſerved it, on the third of July, equal to a ſtar of the third magnitude, and, on the eleventh of the ſame month, it was hardly equal to one of the fourth. On the tenth of Auguſt it was reduced to the appearance of a ſtar of the fifth magnitude, and from this time it grew daily leſs and leſs till quite loſt to the ſight. After it had thus abſolutely diſappeared, the place, where it had been ſeen, continued ſix months vacant. On the ſeventeenth of March following, the ſame obſerver ſaw it again, in exactly the ſame place, equal to a ſtar of the fourth magnitude. On the third of April, 1671, the elder Caſſini ſaw it, it was then of the bigneſs of a ſtar of the third magnitude, he judged it to be a little leſs than that in the back of the conſtellation; but, on the next day, repeating the obſervation, it appeared to him very nearly as large as that, and altogether as bright; on the ninth it was ſomewhat leſs; on the twelfth it was yet ſmaller, it was then leſs than the two ſtars at the bottom of Lyra; but, on the fifteenth, it had increaſed again in bigneſs, and was equal to thoſe ſtars; from the ſixteenth to the twenty-ſeventh of the ſame month he obſerved it with a peculiar attention; during that period it changed bigneſs ſeveral times, it was ſometimes larger than the biggeſt of thoſe two ſtars, ſometimes ſmaller than the leaſt of them, and ſometimes of a middle ſize between them. On the twenty-eighth of the ſame month it was become as large as the ſtar in the beak of the Swan, and it appeared larger from the thirtieth of April to the ſixth of May. On the fifteenth it was grown ſmaller; on the ſixteenth it was of a middle ſize between the two, and from this time it continually diminiſhed till the ſeventeenth of Auguſt, when it was ſcarce viſible to the naked eye. This ſtar therefore, during this ſingle appearance, was two ſeveral times at its full bigneſs and ſplendor, in the beginning of April and in the beginning

beginning of May 1671. This is a singular event; it is not recorded to have happened to any other of these stars, but the punctuality of Cassini's observation fixes it as a certainty that this did so.

On comparing the observations of these two years, it appeared that the new star was seven months in returning to the same appearance in the heavens. From this time it was expected that it would be seen again in February 1672, but it was sought for at that time in vain by those who would not have failed to find it had it been visible; however, Hevelius distinguished it on the twenty-ninth of March in the same year. It was in its exact place in the heavens, but then appeared only as a star of the sixth magnitude; after this it never appeared at all, so that there are evidently natural irregularities, or changes, in the appearance of these stars.

The third re-apparent star in Cygnus was discovered by Kirkius, it was not absolutely the first time the star had been seen, so that it could not properly be called a new one. This astronomer observed, in the year 1686, that the star in Cygnus mark with the letter χ, in Bayer's catalogue and tables, and mentioned as of the fifth magnitude, augmented and diminished its diameter and its lustre in the manner of that called the new star in the neck of the Whale. In the middle of July, 1686, he could not find any star where Bayer had placed this; but, on the nineteenth of October following, he found, exactly in that place, a star of the fifth magnitude. From this time he watched it narrowly, and found it diminish in size and in lustre to the succeeding February, at which time he quite lost it, not being able to distinguish it even with telescopes. On the sixth of August following he saw it in its old place with a four-feet telescope, but he could not distinguish it by the naked eye till the October after, and from this time he saw it till the February succeeding. In the September 1655 he hoped to have seen it return to its place again, but he sought in vain; he carefully examined the place with an eight-feet telescope, but he saw nothing of it till the twentieth of October. In December, 1688, it was in its full splendor, and in the January following. From this time, it diminished till the thirteenth of April, when the eight-feet telescope would no more shew it. In 1692 Maraldi declared, that he could see no change of any kind in it; but in 1694 there was no vestige of it in the place where he had before observed it till the sixteenth of April. He looked for it again at the latter end of August in the same year, and saw nothing of it, no trace nor vestige even by powerful telescopes. It disappeared from the middle of July to the end of August, and from this time it never appeared again until the thirtieth of July, 1695, and it was then so small as to be very difficultly seen by the naked eye. From this time it encreased a-pace in light and bigness, for, on the second of August, it equalled a star of the sixth magnitude, on the twelfth it was of the bigness of one of the fifth, and it continued encreasing till the end of that month. In the beginning of September it was again smaller, and from this time it gradually decreased till the middle of October, and was then again quite lost. It appears, that, in the year 1695, this star was at its full lustre and bigness on the thirty-first of August, and comparing these appearances, observed by Maraldi, with those set down by Kirkius, it appears that the period of its variations is about thirteen months and ten days, or 405 days: but it appears also to be subject to those natural changes and apparent irregularities of the others, having been invisible for three whole years from 1698 to 1701, though sought for at the times when it

ought

ought to have been in its full lustre. In the year 1712 it was seen in the middle of May equal in size to the φ, of Cygnus; on the ninth of June it was of the size of the inform star that is near it, but on the sixteenth of the same month it was much smaller; in 1715 it was sought after in June, but in vain; in August it was seen equal to the inform star near it, forming an isosceles triangle with that star, and another very small one not visible, except in clear nights. Comparing this last observation with that in the year 1695, we see, that, in this interval, which is about twenty years, it has had about eighteen revolutions, each of 405 days, which is in some respects conformable to the computions made from a comparison of its first appearances with those of 1695. The times of its re-appearance agree therefore extremely well with the period established by Maraldi, notwithstanding, that, in the course of its different revolutions, there have been very considerable variations in its apparent bigness.

Beside these several re-apparent stars, characterised and established in so strong and certain a manner by the earlier astronomers, there have been many spoken of by the later. Cassini, the elder, gave accounts to the Paris academy of a considerable number of stars he took to be of the changeable or re-apparent kind, but they are almost all minute ones, so that they are not so striking to the eye, nor is the observation of them so easy. He has mentioned one of the fourth magnitude, and two of the fifth, in the constellation Cassiopeia, neither of which is named by any astronomers, although several have taken an account of that constellation, and have very exactly marked down smaller stars than these. He afterwards saw five more in the same constellation, three of which disappeared soon after he had shewn them to the curious at the observatory; he discovered two others in Eridanus, one of the fourth, the other of the fifth magnitude, in places where none had been seen by any other before, and where himself had not seen them till that time, though he had made not less careful observations. This part of the heavens had been also carefully remarked on account of the passage of the comet that had then last appeared, and had passed over it. The astronomers had taken account of all the stars in it on that occasion, but they had not mentioned any such as these. Four others he discovered of the fifth and sixth magnitude toward the north pole, a part of the heavens so frequently the object of the astronomers observations, that they would have been described before, if they appeared constantly. He observed also that the star, which Bayer places near his ε, in the Little Bear, is no more seen, or seldom at the utmost. That marked in the same catalogues, α, in Andromeda, had disappeared some time, and appeared again in 1695; that instead of the single star, marked in the knee of that constellation, there have appeared two a little to the north of the place, and that the star marked was considerably less than represented; that the star, which Tycho Brahe places at the end of Andromeda's chain, and calls of the fourth magnitude, was, in 671, scarce large enough to be visible; and that which is called the twentieth in his catalogue, in Pisces, was not visible.

These were observations Cassini left to the academy at Paris for hints toward farther investigation. Since that time, Maraldi has also observed certain remarkable changes in the appearances of the fixed stars. The star in the leg of Sagittary, marked by Bayer, and said to be of the third magnitude, appeared in the year 1671 no larger than the sixth. Halley, in 1676, found it again of the third magnitude; in 1692 it was scarce possible to see it, it was so small; and, in 1693 and 1694, it was

was again got up to the fourth magnitude. Halley has marked that in the right arm of Sagittary as of the third magnitude, but it has been much ſmaller ſince; that in the thigh of the ſame conſtellation, the κ of Bayer has diſappeared, and afterwards been ſeen again; Maraldi ſaw it in 1699 of the ſixth magnitude, and in 1709 he diſcovered it to be a cluſter of two ſtars at thirty-five minutes diſtance from one another. The ſame variation has been remarked in that of the tail of the Serpent, marked ψ, by Bayer. Tycho and Bayer both call this a ſtar of the third magnitude. Montanari has mentioned it as of the fifth, and it afterwards appeared again of the third. The ſtar [illegible], in the Lion's head diſappeared many years, but it was again ſeen by Montanari in 1667; in 1691 Miraldi alſo ſaw it, but extremely ſmall. The ſtar θ, of the ſame conſtellation, which Tycho and Bayer have marked as of the fourth magnitude, was inviſible in 1693. The ſtar γ, of the ſixth magnitude, in the breaſt of the Lion, was not viſible in 1709, but, to the aſtoniſhment of the Engliſh, as well as French aſtronomers, (for it is hard to ſay in which kingdom the diſcovery was made) eight ſtars were at once ſeen in the place of it, not one of which is marked in any of the earlier catalogues. The ſtar, in Meduſa, marked β, by Bayer, was perceived by Montanari to be of different bigneſſes in different years; in the whole year 1693 Maraldi could ſee no change in it, but in 1694 he ſaw it vary many times. At ſome times of this year it appeared of the ſecond, at ſome of the third, and at others only of the fourth magnitude. The ſtar γ, in the right ear of the Great Dog, is ſet down, by Tycho and by Brahe, as of the third magnitude. In 1670, according to Montanari, it was not at all viſible, but in 1692 and 1693 it appeared again but equal only to a ſtar of the fourth magnitude. In the ſame conſtellation, Montanari obſerved alſo four ſtars not named by Bayer, which he judged to be re-apparent, and in the year 1695 he found the ſtars β and γ, both of the ſecond magnitude, in the Ship, had diſappeared.

In the year 1704 a new ſtar was diſcovered in the conſtellation Hydra, Maraldi firſt obſerved it; at that time it ſtood in a right line with the two laſt ſtars of the tail, the β and γ of Bayer. It is true that Montanari mentioned the having ſeen this ſtar in 1670, but it had been ſought in vain from that time. The obſervation of Montanari fell into the hands of Maraldi in 1705, and he ſought very carefully for the ſtar, but there was no veſtige of it in the place. He continued, occaſionally, to look at that part of the heavens afterwards, in hope it might ſome time re-appear, and, in 1704, he ſaw it in the very place where it had been obſerved thirty-four years before by Montanari. It was of the bigneſs of a ſtar of the fourth magnitude, and very bright; it continued of the ſame ſize till the beginning of the ſucceeding month, and from that time it became leſs and leſs to the end of May, when it totally diſappeared to the naked eye, but the teleſcope ſhewed it in its place a month longer, ſtill growing leſs and leſs, till at the end it was entirely loſt. At the end of November, 1705, that part of the heavens then coming from the blaze of the ſun's beams, the ſtar appeared again, but very ſmall and faint, and continued viſible to the end of February 1706, when it entirely diſappeared. It did not appear again till the middle of April 1708; it was then ſomething larger than the ſtars of the ſixth magnitude, encreaſed in ſize to the eleventh of May, but from about this time it began again to diminiſh. It appeared again in 1709 on the twenty-third of November, and ſoon decreaſed in bigneſs. On the ſeventh of February, in 1710, it was ſo ſmall that the

the telescope hardly discovered it. On the twenty-fourth of May, 1712, it re-appeared the fifth time, and remained in sight till the end of June; when it was again wholly lost to the view.

Since the time of these several observations, the attention of astronomers has been very much employed on the appearances of the fixed stars, and they have found other variations among them. The most southern of the two stars, placed by Bayer under the southern hand of Virgo, has wholly disappeared; the other is seen as he places it, but no one has yet found the first to re-appear. Riccioli mentions a star in the northern thigh of the same constellation, which is not now to be seen. Bayer had not marked this, so that, probably, it was not visible in his time, and was properly a new star of Riccioli's observation, and has disappeared since. There is not, at this time, any vestige of that star of the sixth magnitude, which Bayer has placed in the Western Balance at ten degrees, and that of Scorpion with a north latitude of three degrees. Tycho and Bayer found a star of the fourth magnitude in the eastern scale of the Balance. Hevelius sought it in vain, and declared that it had disappeared, but it was again seen afterwards, not so large indeed as they have described it, but remarkably bright, and it has, from time to time, disappeared and appeared again in that place. The star of the fourth magnitude, seen by Cassini the elder, in the Hare, has been since seen at times, and lost at times, in the same place; and it has been observed, both by him and by Halley, that the star of the third magnitude in the hinder leg disappeared at times. This was sought in vain for several years, and at length it appeared again visible to the naked eye, and of the size of a star of the sixth magnitude. On examining it in 1699, at its appearance after so long a loss, by the means of powerful telescopes, it was found to be composed of two stars, distant from one another about five and thirty minutes in latitude.

There is not any phœnomenon in the heavens that has more surprised those who have considered, or indeed known these things at all, than this of the appearance of a new star in the heavens. That in Cassiopeia was most taken notice of because of its extraordinary size and brightness, and many have supposed it a single appearance of its kind in the heavens. It has been guessed by some to have been a comet, and by others a planet on fire. So wild and so absurd are the opinions of men who are hasty to determine, and slow to examine. I have brought together these numerous instances, all supported by the most authetic testimony, to shew that there was nothing singular in that appearance, except its bigness; for that there are, among the fixed stars, others which appear only at times, and which do it in different degrees. The fixed places of these new stars sufficiently prove, that they are neither comets nor planets, as indeed does also the nature of their light. Their return at certain times, though not with a perfect regularity, shews that their appearance is owing to a motion in themselves, and that a periodical one. And it is evident from their want of any sensible parallax, that they are absolutely in the region of the fixed stars, and that they have this motion only about their own axis, and remain otherwise at rest.

The probable account of them must be, therefore as already hinted, that they are globes of solid matter, obscure on one part of their surface, and luminous on the other. And as a revolution round about their own axis would account for all the appearances, were they regular, there is this particular motion

motion also in the poles of that revolution round the axis. This will shew us, occasionally, more or less of the enlightned surface; and all the rest will follow from the other.

If this be the case, the singularity, in regard to that of Cassiopeia, is, that the time, taken up by its revolution, is so long, or, that the variation from the revolution of the poles is so great; but, be it from either, there is no doubt of its appearing again.

NILE. A name by which some of the old astronomers have called the river among the constellations of the northern hemisphere, more generally known by the name Eridanus. *See* ERIDANUS.

NILI DONUM. A name by which some have called the Triangle.

NIMROD. A name given by some to Bootes, one of the northern constellations. There have been a set of writers, Schiller, Schickard, and the like, who would not suffer the pagan history to remain in possession of any one of these constellations. In these cases, where they leave the figure as it was, and only alter the name, the mischief is not great; but they become intolerable where their enthusiasm alters the form of the constellation. Schiller has done this almost throughout the heavens, he has placed the twelve Apostles in the room of the twelve signs of the zodiac, and he has converted the Great Bear into St. Peter's boat, and the constellation Draco into the innocents slain by Herod. This creates confusion, and is unpardonable.

NITAC. A name by which some, who are fond of uncommon words, call the zodiac; it is one of the Arabic names for it, and signifies, in that language, a belt.

NIXUS. A name by which some of the Latin writers have called the constellation Hercules.

NOAH's ARK. A name given by Schiller to the constellation Argo, or Navis, the Ship.

NOBU. A name by which some of the astrological writers have called the planet Mercury; it is the Chaldee name of that planet, and it signifies an attendant.

NODUS CŒLESTIS. A term which occurs in Cicero and some of the other Latin writers as a denomination of an arrangement of stars. It means that part of the constellation Pisces, which consists of the string or cord that ties the two fishes to one another.

NOGAH. A name by which some, who are fond of uncommon words, have called the planet Venus; it is one of the Hebrew names of that planet, and signifies, in the proper sense, light or splendor; it is therefore a very proper name for so bright a planet.

NOON. That time of the day at which the sun comes to the meridian of any place; or, in proper words, that time of the day at which the meridian line of that place is pointed directly at the sun's centre, or, if the plane of it were continued up to the heavens, would cut the sun's centre in its course.

The meridian of any place is a great circle of the earth drawn through that place, and through the two poles of the earth. Now as these two poles keep their place at all times, and the part of the earth, through which the line is drawn, keeps also its place, this circle must, with respect to that place, be a fixed circle, and consequently it must, like all other fixed parts of the earth, turn round with the rest of

of its ſurface in its revolution about its own axis. Now as this part of the ſurface, or this line, is, by this revolution, brought to point to the ſun directly once in twenty-four hours, the time, when it does ſo, is that when the ſun is fartheſt from the horizon in that place, that is the noon, or the mid-day at that place.

In the ſame manner this circle on the earth's ſurface is, by the general revolution of the earth, brought once, in every twenty-four hours, directly oppoſite to every ſtar, and the point of time, when it is ſo, is the point at which that ſtar is ſaid to be at its meridian. The common form of expreſſion on this ſubject is, that, at ſuch an hour, ſuch a ſtar comes to its meridian, as if the ſtar travelled to it. But in this, as on all other occaſions of this kind, we uſe the common ways of ſpeaking inſtead of the proper. The term is not, a ſtar's coming to the meridian, but the meridian travelling to the ſtar; and thus it is that aſtronomers are to be underſtood when they ſpeak of the riſing and ſetting of the ſun and the ſtars, they ſpeak only in conformity to appearance, and the ordinary method of expreſſion, for the ſtars and the ſun keep their place for ever, and this revolution of the earth does all the matter.

NORTH. We are to obſerve, that all the books we know of in aſtronomy have been written by perſons who have lived on the north ſide of the equator, and have had the north pole, in the countries in which they lived, elevated above the horizon. As this happens to be the caſe, there is no confuſion in the terms that are uſed, which there would be in the books of writers, ſome of whom ſhould have lived on the one, and ſome on the other ſide of the equator; and to ſome of whom the north, and to others the ſouth pole were elevated above the horizon. Thus, for inſtance, we name the two equinoxes according to this ſituation, and very familiarly call that in March the vernal, and that in September the autumnal equinox; but, if we had books of aſtronomers who had lived on the ſouth ſide of the equator, we ſhould find a very different language in them, for their autumn begins in March, and their ſpring in September, ſo that they would as naturally call the September equinox the vernal, and the March the autumnal equinox, as we do the contrary by theſe names. In the ſame manner it would be univerſal with them to call the ſouth pole the upper part of the heavens, as it is with us to call the north pole by that name: and as we expreſs any motion, that is made from ſouth to north by the name aſcending; and any motion, that is made from north to ſouth, deſcending; juſt on the contrary, thoſe who ſhould live in countries to the ſouth of the equator, and ſee the ſouth pole elevated above their horizon, as they would call that the top of the heavens, would call every motion, from north to ſouth, aſcending, and every motion, from ſouth to north, by the name of a deſcending motion.

To underſtand rightly where the north point is, we are to conſider the horizon as forming a circle, which is interſected by another circle, the meridian, and by it divided into two equal parts. The point of interſection of theſe two circles, which is neareſt the north pole, is called the north point, or the north; and that, which is neareſt the ſouth pole, is called the ſouth, or ſouth point. *See the article* CIRCLES *of the Sphere.*

NORTHERN CROWN. A name by which the aſtronomical writers call one of the conſtellations, the Corona Borealis of the Latin writers, a ſmall one placed between Bootes, Hercules, and Serpens, and remarkable for a

ſtar

ſtar of the ſecond magnitude in it called Lucida Coronæ. The bent leg of Hercules is immediately over the top of it, and the head of the Serpent is juſt under it, all at a ſmall diſtance.

The antients counted eight ſtars in the Corona Borealis, and they were a long time followed by the later writers. Ptolemy gives the account at eight, and Tycho and Hevelius make them of the ſame number, but Flamſtead makes them twenty-one. Of theſe there is not one of the firſt magnitude, and only one of the ſecond; this is the Lucida Coronæ, and many have been for reducing this to the third. The magnitude of the ſtars, according to theſe claſſes, is indeed very ill determined, ſome making thoſe of one claſs that others place in another, nor is it a wonder, for ſcarce any two ſtars in the firmament are truly of the ſame bigneſs. Theſe ſtars are principally diſpoſed in the circle of the Crown, ſeven of the old eight are ſo; the points or rays have very few of them.

The Corona Borealis is ſo univerſally ſpoken of among the old writers, that it is probable the Greeks had it, among the reſt of their aſtronomy, from the Egyptians. They have, however, according to their cuſtom, annexed one of their fables to it, and ſpeak of it as of their own invention.

They tell us this was the crown of Ariadne, and that Bacchus placed it among the ſtars. They ſay, that when this beauty was married to Bacchus in the iſland of Dia, all the gods gave her ſome preſent. This crown was the teſtimony of reſpect from Venus, or from that goddeſs and the hours; or, as others will have it, Bacchus gave her the crown himſelf as a preſent to purchaſe her conſent, and that ſhe was taken with the gaiety and ſplendor of the gift, and accepted him.

However they have diſputed this point, they all ſay it was the work of immortal hands; Vulcan, they tell us, fabricated it, and it was wrought of gold and Indian gems; and that it was, by the power of Bacchus, for whichſoever reaſon, carried up into the heavens.

NORTHERN HEMISPHERE *of the Earth*. A term uſed by the geographers to expreſs one half of the ſurface of the earth, and often referred to by the aſtronomers under the name of the earth's northern hemiſphere. It is that half of the earth extending from the equator to the north pole. The equator, or, as it is vulgarly called, the line, divides the earth into two equal parts, being drawn round it at equal diſtance from the two poles; theſe two hemiſpheres may therefore be very properly called the northern and the ſouthern hemiſphere, as they fall between the line and the north, and that and the ſouth pole.

NUCLEUS *of a Comet*. Aſtronomers uſe this term to expreſs the body of the comet, or the whole of the appearance, excepting the tail. They alſo ſometimes call this the head of the comet; this is the general ſignification of the term Nucleus, when applied to a comet, but there are ſome who have uſed it in another ſenſe. The body of a comet, when viewed through a teleſcope, has not at all the look either of a fixed ſtar or planet, but appears a glowing heated maſs; this is ſometimes of an uniform colour and appearance, and ſometimes it is brighter in the middle and darker at the edges; ſometimes alſo, while this central part appears entire, the edges ſeem cracked and lacerated. Such appearances are deſcribed by aſtronomers in their accounts of continued obſervations on the comets. In this caſe the word Nucleus is uſed, not, as in the general, to expreſs the whole body of the co-

 met,

met, but only to ſignify that part of it which appears different, from the reſt in its centre.

NUMBER, *plane.* By this term aſtronomers expreſs any number that may be produced by the multiplication of one number by another. Thus eight is a plane number, becauſe it may be produced by four multiplied by two, for two times four make eight; twenty is a plane number, becauſe it may be produced by four, for four times five are twenty.

In this inſtance, the number four and the number five are called the ſides of the plane number twenty, and in the ſame manner the two and the four, in the former inſtance, are the ſides of the plane number eight. In general, thoſe numbers, which, being multiplied by one another, produce a plane number, are called ſides of the plane.

Theſe plane numbers are often repreſented, in aſtronomical uſe, by lines inſtead of figures, and only theſe can be ſo repreſented. Thus, if we ſuppoſe the number twenty to be repreſented in this manner, we ſhall firſt ſuppoſe the units, of which that number conſiſts, to be repreſented by ſo many ſquares, and theſe ſquares are then to be placed in the form of a rectangle. In this manner the number twenty is repreſented by a rectangle, one of the ſides of which is four, and the other is five. On this the doctrine of ſquare numbers depends. *See* SQUARE.

NYCTYURUS, *the Keeper of the Night, or Guardian of the Night.* A name given by many of the old Greek writers to Saturn; we meet with it in Plutarch and in Aratus. The Greeks took conſideration in their naming of the ſtars, and they uſually did it from ſomething that was very ſingular and appropriate. The other names, by which they alſo called Saturn, may ſerve to explain their intent in this. Among theſe, we find Phænon and Phaeton, which ſignify apparent. Plato has been cenſured, for his calling this planet Phænon, by thoſe who ſuppoſed Phænon could mean nothing but bright or ſhining; but this is not the ſenſe of the word when applied to Saturn. Phænon ſignifies apparent, in any ſenſe of that word, for the verb, from which it is derived, only ſignifies to appear. What was intended to be conveyed by it in this uſe, was not that the planet, to which it was given, was the brighteſt of all the ſet, for it is, on the contrary, the dulleſt; but that it was that which was moſt conſtantly ſeen in the heavens. This is a character of Saturn, and is owing to this plain cauſe, that it is not ſo often hid under the ſun's beams as any of the others; for this reaſon it was alſo called by Plutarch by a name which expreſſed the night-watcher, or guardian, Nyctyurus, becauſe ſo generally apparent in ſome part of that time.

O.

O.

OAK ROYAL. One of the new ſouthern conſtellations, eſtabliſhed in commemoration of the tree of that ſpecies, in which an Engliſh monarch was preſerved. *For an account of its place in the hemiſphere, and the ſtars which it contains, ſee the article* ROBUR CAROLINUM.

OBLIQUE ANGLE. A term uſed by mathematicians to expreſs any angle that is different from a right one. If one of the two lines which form the legs of an angle be perpendicular to the other, it is called a right angle; if they be farther removed from one another, it is called an obtuſe; if they be brought nearer to one another, it is called an acute angle; but both theſe, whatſoever be their quantity, are called in diſtinction from the right angle, *oblique*. *See* ANGLE.

OBLIQUITY *of the Ecliptic*. Beſide the apparent daily revolution of the ſun round the earth, which is from eaſt to weſt, and is performed in twenty-four hours, and is common to the ſun, and to all the other ſtars, the ſun has, to ſpeak according to appearances, a particular motion alſo which he makes from weſt to eaſt, in direct contrariety to the other; this will be found on comparing the ſituation of the ſun with that of the fixed ſtars at different times of the ſame year. If, for example, we obſerve the hour of the paſſage of the ſun, and of certain fixed ſtars through the meridian, we ſhall find, that the interval of time between the ſun's paſſage through it, and that of any fixed ſtar, ſituated to the eaſtward of the ſun, does diminiſh every day; and, on the contrary, if we take the hour of the paſſage of the ſun through the meridian, and of a ſtar to the weſt of the ſun, we ſhall find, that the interval of time, between the paſſage of the one, and of the other, encreaſes every day. We have abundant proof of the fixed ſtars being immoveable in their places, and the reſult of the experiment therefore appears to be, that the ſun does continually approach toward the ſtar to the eaſt, and depart from thoſe to the weſt; or, in other words, that the ſun travels on continually from the weſtward toward the eaſt. If the obſervations be continued a ſufficient time, the appearances will, at length, be exactly as they were in the firſt obſervation. This will happen at a certain time, which time marks the revolution of the ſun round the earth, as it appears to be, and this period of time, between its leaving that point, and coming to it again, is the ſolar year.

This was one of the earlieſt obſervations in aſtronomy, and as ſoon as this was made, as it was agreed that the ſun had a motion peculiar to itſelf, which was performed from weſt to eaſt, and compleated a revolution in the courſe of a year; the next obſervation

vation was, that this motion was made round the poles of the world, or the equator. As the daily revolution of the fame fun round about the earth, and that of the ftars with the meridian altitude of the fun, varies every day, and that, in fuch a manner, that, at fome times of the year, it is more elevated above the horizon than at others, in the quantity of half a quarter of a circle, it hence refults, that the diftance of the fun from the north pole, which we fuppofe to have at all times the fame height above the horizon, is fubject to the fame variation. Its diftance from the equinoctial, which is a great circle of the fphere, placed on each fide at ninety degrees diftance from the poles, varies alfo continually; for when we have fixed the points of eaft and weft, at which the equinoctial cuts, or interfects the horizon, we perceive, that the rifing and the fetting of the fun anfwers every day to a different point in the horizon. Sometimes it happens exactly at the interfection of the equator with the horizon; this is the cafe in the equinoxes, when the day and night are exactly of the fame length, at other times it departs from thefe points in the place of its rifing and its fetting to a certain diftance, and after this it feems to come back again the fame way.

This diftance from the equator is equal on one fide, and on the other; it goes to an equal remove, north and fouth, in fuch a manner, that in winter the fun departs from the point of fetting at the equinox to the fouthward, juft as far as in the fummer he departs from the point of his rifing toward the north, and thus it is feen, in the diftances before and after the equinoxes, in points diametrically oppofite.

It follows then, that the fun is continually in fome part of a great circle which interfects the horizon, and is enclined feveral degrees to the equator; this circle is called the ecliptic. The parallel circle, which the fun defcribes daily in his revolution round the earth, when it is at its greateft diftance from the equator, toward the north, is called the tropic of Cancer, and the parallel circle which it defcribes when it is at its greateft diftance fouthward, is called the tropic of Capricorn. Thefe circles are called tropics, which fignifies places of return, becaufe when the fun has arrived at them he returns back again; and aftronomers call thofe days, when the fun is in the tropics, folftices, diftinguifhing them by the names of the fummer and the winter folftice, becaufe about thefe times the fun's meridian altitude, and his places of rifing and fetting have no fenfible variation.

In order to determine the greateft declination, or obliquity of the ecliptic, with regard to the equator, we are to obferve the meridian height of the fun's centre above the horizon, when it is in its greateft elevation, which is about the twentieth day of June. Six months after, or thereabouts, we are to obferve the meridian altitude of the fun when it is at its leaft elevation. Thefe two altitudes are to be corrected according to the rules which regard refractions and parallaxes, and we are to take the difference, which being equally divided into two parts, gives the true obliquity of the ecliptic, which is at this time about 23°. 28′. 20″.

OBLIQUE SPHERE. A term very frequent in aftronomical writers, and very important. It expreffes one of the three fituations of the fphere, with refpect to the inhabitants of the earth, and it is that of the three which is of the greateft confequence, becaufe it regards almoft all the inhabitants of the earth. They live in a parallel fphere, who live at either of the poles; they in a right fphere

ſphere who live under the celeſtial equator; but all who live between the equator and either of the poles, that is, in a manner, all the inhabitants of the earth live in an oblique ſphere, and ſee the heavens accordingly.

In order to explain this perfectly, it may be proper to premiſe the meaning of the other two terms, the parallel, and the right ſphere. With reſpect to the firſt it is plain, that whoſoever lives at either of the poles of the earth, muſt have one of the poles of the heavens over his head, and the other under his feet; that is, one of them will be in his zenith, and the other in his nadir; and conſequently the equator will be to ſuch a perſon coincident with the horizon, and all its parallels, parallel to it; he is therefore ſaid to live in a parallel ſphere, that is, he has a parallel horizon.

The right ſphere may require a few more words to explain it, but after this the oblique will be very eaſily underſtood; if we ſuppoſe the earth to be viewed from an infinite diſtance, the eye being in the place of the equator, we ſhall find, that the equator, and all its parallels, will appear only as ſo many right lines, only half of each of thoſe circles will be ſeen, and being viewed from a point thus circumſtanced, thoſe ſecond circles will appear no otherwiſe than as right lines. A perſon who lived under the equator, would be, in ſome degree, in the ſame ſituation, he would have both the poles in his horizon, and the celeſtial equator, and all its parallels, would cut his horizon at right angles, conſequently he would live in what is called a right ſphere, in diſtinction from that parallel ſphere which has been, and that oblique ſphere which is now to be mentioned.

This oblique ſphere is the term uſed then to expreſs that ſituation in which the globe of the earth, and the ſphere of the heavens, do relatively preſent one another to the eye of thoſe who live between the equator and the poles; and this great compaſs of the earth, taking in all who have written of the heavens, and almoſt all who have conſidered, or looked at them, it is the moſt material to be truly underſtood.

In whatſoever part of the temporate zones a perſon lives, and in whatſoever part even of the torrid and frigid, excepting only at the centre of either of the latter, he will have the celeſtial equator cut his horizon in an oblique direction; in conſequence of this, the equator being reckoned the ſtandard circle on the globe, he is ſaid to have an oblique horizon, or to live in an oblique ſphere, for theſe are ſynonimous terms. In whatever direction the equator is with reſpect to the horizon, in that direction alſo are the ſeveral parallels to that circle, or, as they are uſually termed in ſimple words, the ſeveral parallels. The equator therefore cutting the horizon at right angles to thoſe who live under the line, all its parallels alſo, to ſuch perſons, cut the horizon in right angles, and in the ſame manner the equator to all people, between the equator and the poles, cutting the horizon at oblique angles, all its parallels do alſo cut the horizon at oblique angles to the inhabitants of this part of the globe, and this is what is underſtood by the obliquity of the ſphere to thoſe people.

It is to be underſtood, that to an inhabitant in an oblique ſphere, when we ſpeak of all the parallels to the equator, cutting the horizon at oblique angles, we mean, that he is to conceive no more parallels, (theſe circles being all imaginary, and in number what people pleaſe,) than do appear in ſome part of that horizon; for ſuppoſing a great many parallels drawn between the equator and either pole, as eſtabliſhed circles of the ſphere, ſome

of them would be entirely above, and some of them entirely below the horizon: and all that is to be understood of those in this doctrine of the obliquity of the sphere is, that they would, if their places were sufficiently extended, cut the horizon at oblique angles; so that, to use the most proper and punctual terms, all the parallels in the sphere of heaven, have, in an oblique sphere, their planes oblique, to the plane of the horizon. This is the proper character of the oblique sphere; but, in a work of this kind, where terms were to be explained, more than this was requisite to make it intelligible to those who have not been conversant in the terms which regard the science.

OBTUSE ANGLE. The term by which mathematicians express that angle, be whatsoever its quantity, which is greater than a right one. A perpendicular line drawn down to touch an horizontal one, forms what is called the right angle, and any thing greater than this, that is, any angle formed by separating the two lines, or legs, still farther asunder than they are in this figure, is called *obtuse*.

OCULI MUNDI. A term by which we find the stars expressed in some of the old writers. This might seem a mere poetical phrase, but there is more in its foundation. The stoics made the world, Mundus, by which term they understood the whole universe a corporal deity, and they supposed the stars to be the eyes of that body, with one or other of which it saw all parts of the earth. The omniscience of a deity was a necessary acknowledgment in any system of religion; but what a poor and mean way was this of accounting for his seeing all things; how unworthy, when we see it impartially, the name of that sect who adopted it.

OCULUS JOVIS, *the Eye of Jupiter*. A name by which some, who are fond of affected terms, call the sun. The term occurs in some of the old Latin writers.

OCEAN. A name by which some of the astronomers have called the constellation Eridanus.

OCLAZOS. A name by which we find some of the old Greeks calling that constellation, which others of their writers have called Engonasin, and others Hercules; they seem to have received it without a name from the Egyptians.

OCTAPUS, *or* OCTIPES. A name by which some of the astronomical writers, as they follow the Greeks in their orthography, or the Latins in theirs, call the constellation Cancer.

OCTIPES, *the eight Foot*. A name by which some of the astronomical writers have called the constellation Cancer; others, according to the Greek orthography, call it Octapus.

ŒSCULAPIUS. A name given by many of the old writers to that constellation in the northern hemisphere, more usually called Ophiucus. The Greeks pretended, that the figure owed its origin to Œsculapius, and that the Serpent between his legs, and perishing under his gripe, represented his skill in physic, by which he cured the bites of those animals. When we read of the Angius Œsculapii in the heavens, it is this Serpent; they say, Jupiter placed the physician in the skies at the request of Apollo. *See* OPHIUCUS.

OKAB. A name by which those, who are fond of out of the way words, commonly call the constellation Aquila; it is one of the Arabic names of that sign, and signifies a black eagle.

OLOR, *the Swan.* One of the constellations in the northern hemisphere, pretended by the Greeks to be the same which Jupiter used to debauch Leda, and afterwards raised among the constellations. *For its situation, and number of stars, see* CYGNUS.

OPHIS, *or* OPHIS OPHIUCI, *the Serpent, or* OPHIUCUS's *Serpent.* A name by which some have called the Serpent in the northern hemisphere. Ophis is Greek for a serpent. *See* SERPENS.

OPHIUCUS, *Serpentary.* One of the constellations in the northern hemisphere; it is one of the old forty-eight, and is mentioned by the earliest writers on astronomy; it was probably in its origin some part of the hieroglyphic writing of the Egyptians; but that being understood only by themselves, the Greeks have explained it by some of their fabulous history. Many of the modern writers, out of that natural aversion men have for things they do not understand, have given up the Greek denomination, and call it Serpentarius.

Serpentary, or Ophiucus, is a very large constellation, and comprehends a great number of stars. The figure, as represented in the schemes of the heavens, of whatsoever time, (for these are strictly alike, and are probably the very same that were received from the (Egyptians, is that of a man standing, with his legs at some little distance from one another, and an immense, and monstrous Serpent between them, a part of the body of which he also grasps with each hand; the figure is represented naked, except for a loose robe about his waist, and over his shoulder, and he has nothing upon his head.

Ophiucus is placed under the head of Hercules, and over the signs Libra, Scorpio, and Sagittary; the Eagle is on one side of him, though at a distance, and on the other the leg of Bootes, though at a greater. The head of Hercules comes very near to the head of Ophiucus, and his arm with the club in; it is between the left arm of Ophiucus, and the upper part of the body of the Serpent. The left foot of this constellation touches Scorpio, and he seems as if walking from Sagittary to Lyra.

The antients have allowed twenty-nine stars to the constellation Ophiucus; Hipparchus counted so many in it, and Ptolemy, his faithful follower, has set down the same number; Hevelius has raised the account to forty, and Flamstead makes it seventy-four.

Among all this number there is only one star of the second magnitude, and this is in his head; there is not one of the first, and but few of the third: the great number are of the smallest kinds; they are distributed with a tolerable regularity over the whole figure. There are several in the head, fewer indeed of the tolerably large ones on the body than might be expected, but a considerable number on the legs, and more on the arms. Upon the whole, the constellation is as conspicuous as most in the hemisphere.

What the Egyptions meant by the figure of a man striding over a serpent, is not easy to say; but the Greeks, who never failed to adapt some part of their history to every one of their figures, tell us, that this constellation represented Carnabos, sovereign of the Getæ, a people of Mysia. They say, that he reigned as long ago as when men first began to sow corn.

corn. Ceres is ſaid to have inſtructed men in this uſeful art, and, to that purpoſe, to have commiſſioned Triptolemus, whom ſhe had educated, to ſpread it throughout the world. That he might have expedition in his courſe, they ſay, ſhe placed him in a chariot drawn by dragons. Among other of his viſits, Triptolemus, they tell us, came to Carnabos, who at firſt received him graciouſly, but determined to deſtroy him in the end. They ſay, he firſt killed one of the dragons that drew his chariot, that he might have no poſſibility of getting away, and then was about to murder him; but Ceres came, and fixing another dragon to the chariot, carried him off with her, and to puniſh Carnabos, placed his figure in the ſkies, as an eternal memorial of his ingratitude, in the act of killing the ſerpent, or dragon, which had belonged to the chariot of the viſitor.

This, however, is but an ill adapted ſtory. The being removed into the ſkies has been, on all other occaſions, conſidered as the greateſt honour, an apotheoſis, and a triumph above all others, ſo that this, making it a puniſhment, ſounds but uncouthly. Hercules was the natural and ready ſtory for ſuch a figure, but they had got an Hercules, killing a dragon, in the ſkies already; however, others, quite diſſatisfied with this account of Carnabos, have thought it better to have two Hercules's, than one ſuch ridiculous ſtory in the account of the heavens. They have called Ophiucus therefore an Hercules alſo, and have diſtinguiſhed him by the name of Lydius. They ſay, this conſtellation was formed in honour of that hero, on his having killed a monſtrous ſerpent at the river Segaris, in that part of the world, who had deſtroyed] a multitude of people, and frighted all mankind from the neigbourhood of the river. The queen of the country, they ſay, ſent him back to Argos, loaded with gifts for the ſervice; and Jupiter, in honour of the exploit, placed him in the heavens, with the Serpent in his hands, ſtruggling and gaping under the furious gripe.

There are other ſtories as to the origin of Ophiucus, but they ſeem rather confuſed accounts of thoſe before eſtabliſhed, than abſolutely new ones; ſuch is that which makes the conſtellation repreſent Triopas, a king of Theſſaly, who, for diſhonouring Ceres, was, after many miſeries, deſtroyed by a dragon, and placed up in the ſkies together with that creature; this is only a blundering account of the ſtory of Carnabos: others call it Phorbas, a ſon of Triopas, and an hero, whom, in commemoration of his exploits, Apollo raiſed, together with a dragon he had conquered, into heaven; but there are others who will have it to be Œſculapius, and call the Serpent Anguis Œſculapii. The conquered Serpent was a very natural emblem of the ſkill he had in medicine, which could cure the bites of thoſe animals; and Jupiter is ſaid to have placed him in the ſkies at the requeſt of Apollo.

Schiller, who will make every conſtellation repreſent a Chriſtian ſtory, has obliterated the Snake, and placed ſome buſhes in its place; he call it St. Benedict among the Thorns. Schickard leaves it as it is; but inſtead of Ophiucus, he calls it St. Paul and the Viper.

OPPOSITE MERIDIAN. A term uſed by aſtronomers and geographers to expreſs that ſemicircle, or half of a meridian, in which the place from which the meridian is denominated is not; but which paſſes through the point of the earth, that is, oppoſite to that of which it is called the meridian.

In

In order to underſtand this perfectly, it is to be obſerved, that a meridian is a great circle which is drawn through both the poles of the earth, and through which it is ſaid to be a meridian. Now as the poles of the earth divide this into two equal halves, or ſemicircles, and the one of theſe, which is that in which the place ſtands, is much more referred to than the other; it is a cuſtom to call this half of the meridian, ſometimes, in abſolute terms, the meridian; in either of theſe caſes the other ſemicircle is called the oppoſite meridian. All the places, through which the ſame ſemicircle paſſes, which is carried through the place whence it is named, are ſaid to be places in the ſame meridian; and all thoſe places, which are exactly oppoſite to theſe, and through which in conſequence the other paſſes, are ſaid to be in the oppoſite meridian.

* OPPOSITION. When we meet with this term in the writings of the aſtrologers it means an oppoſite ſituation of ſome one of the planets, and of ſome fixed ſtar, or ſome conſtellation, when they are juſt half a circle, or one hundred and eight degrees diſtant from each other. This is one of the five aſpects, conſpects, or ſyzygies, ſo famous among the old aſtrologers. They ſuppoſed, that, in theſe, the ſtars and the planets ſhed a mutual influence over one another, or had reciprocal radiations to and from each other; and by means of theſe that they co-operated together in cauſing, or at leaſt in giving ſome ſhare toward the cauſing of events, ſo that they had opportunities hence of fore-knowing them.

The other four aſpects were Conjunction, Sextile, Quadrate, and Trine. In the firſt of theſe they were together, in the ſecond at ſixty, in the third at ninety, and in the fourth at one hundred and twenty degrees diſtance. From all theſe, preſages were made.

OPPOSITES, *or* ANTIPODES. A term by which we expreſs thoſe people who inhabit that part of the earth which is exactly oppoſite to that on which we live, and whoſe feet are therefore directly placed againſt ours, only with the diameter of the earth between. It has been, at one time, accounted hereſy to maintain that there were people thus ſituated, and to this day, among the vulgar, it appears ſtrange, irrational, and improbable, to ſpeak of it; but it is abundantly proved that the earth is round, and very few parts of it are uninhabited. Thoſe places, which are oppoſite to Europe, are not the moſt improper for inhabitants, and, if inhabited (as indeed we know they are) the people, who live in them, muſt have their feet oppoſite to our feet, and be antipodes to us.

There is not any thing more ſurpriſing to thoſe, who are unacquainted with the ſyſtem and ſtructure of the univerſe, than this; but there is nothing ſo evident, or ſo far from improbability. The immediate queſtion is, Why do not theſe people, whoſe feet are oppoſite to our feet, and whoſe heads are downwards, fall off the earth? Whether ſhould they fall, into the ſkies? Certainly the term is ridiculous; the earth is at their feet, and the ſkies beyond their heads, they, as well as we, muſt therefore fall upwards if they ſhould fall into the heavens. In the ſtructure of the univerſe there is a power of gravitation, or attraction, or call it by what name we pleaſe, there is a tendency of all things on the ſurface of the globe toward its centre. This tendency (call it attraction, or by what term we will) does evidently exiſt, and this alone muſt keep the inhabitants of the earth, on whichſoever part of it they live, from falling from its ſurface. The heavens are the place which we look at as upwards, and they muſt have this denomination in whatever part of the earth we live; ſo that

falling to them would be falling upwards and not downwards, from whatſoever part of the earth it ſhould happen. If we could ſuppoſe this power of attraction, by which we are kept upon the earth's ſurface, taken away with reſpect to ourſelves, we ſhould be influenced in a manner we little think; but this is not a place to enquire into that. At preſent the eſtabliſhing as a certainty, in the minds of the uninformed, this doctrine of the antipodes is the point; and this may be done perhaps without having recourſe to any very abſtruſe matters.

In the firſt place it will be allowed, that, if the earth be round, there is a part of it oppoſite to this in which we live; in which, if it be inhabited, the inhabitants muſt be antipodes to us, or muſt have their feet oppoſite to ours; but the earth, to the vulgar eye, rather appears to be a great plane than a ſpherical body. By the term earth, uſed in this ſenſe, we mean the earth and ſea, and this appears the more incomprehenſible to ordinary minds, ſince, if there be ſeas making a large part of the globe, and theſe ſeas elevated in the manner of parts of a globe's ſurface, they imagine that theſe would not keep their convex figure, but would over-run the land; and that, in reſpect to ſuch as ſhould be oppoſite to us, they would as undoubtedly empty themſelves into the ſky, as the people of that part of the globe would fall thither. But that this is the caſe is evident, and the ſame law of nature, which prevented the one, prevents the other. This gravitation, or attraction, (or by whatever name it is called) this tendency of heavy bodies to the centre prevents the running of the ſeas into the ſkies, as well as the men's falling into them; and in the ſame manner the one would be running upwards as much as the other would be falling upwards, and one would be as unnatural as the other. The ſame cauſe alſo preſerves the ſea in its convex form, and prevents its over-running the land in any place. Theſe are the laws; but, to examine the evidence of the fact, let us look into appearances.

If we will examine the manner in which diſtant objects affect our ſight, we ſhall ſee that the largeſt of thoſe equally remote are firſt ſeen: and that as large and ſmall ones advance together, the largeſt are firſt ſeen, and the ſmall ones afterwards. Thus, if a church and a buſh are at the ſame diſtance, and that a very conſiderable one from the eye, the church will be ſeen while the buſh is inviſible; and thus in objects which are in motion, and advancing toward us; if we ſhould ſee, upon a plane, a cart in which the driver ſhould have ſtuck upright his long whip, we ſhould, firſt of all, at a great diſtance, ſee the cart; after this, as it came nearer to us, we ſhould ſee the carter by the ſide, but it would be very long before we diſcovered ſo ſmall a thing as the whip, even though we ſhould have been told that it was put there. Now let us reduce this to the compariſon. If a perſon be ſtanding upon the coaſt of the ſea, and waiting for a veſſel which he knows is to arrive; in what manner ought he to ſee it? why according to the following obſervation, he ought to ſee the ſhip firſt, and, after a great while, he ought to ſee the maſt juſt in the middle of it, that being little more, in compariſon, than equal to the whip of the carman; but it is not thus. Let us enquire then in what manner he does ſee it. He ſees firſt of all, at the greateſt diſtance, the top of the maſt, as it were, riſing out of the water, and the appearance is exactly as if the ſhip was ſwallowed up in the water, and drowned ſo deep. As he continues his eyes upon the object, this part of the maſt, which is above water, grows more and more long, and at length he begins to ſee the top of the deck, and, by degrees, the whole body of the veſſel.

Now let us examine why this is the order in which things present themſelves: if the ſea were a great plane, as ſeems to be the caſe to theſe obſervers, then the ſhip would, in the ſame manner as the cart, have its body firſt ſeen; and, as it advanced much nearer, the maſt, as the whip in the other obſervation: the maſt would not come into ſight by the top firſt, for the top is the ſmalleſt, and not the largeſt part, but the whole length of it together, or, if there were any diſtinction in point of time, the loweſt part of it, for that is the largeſt, firſt.

It is impoſſible to account for the order of its appearance upon the ſeas being a flat ſurface, but the appearance is in this order, and therefore the ſea is not a flat ſurface. We have obſerved, that the part of the ſea, which has been traverſed by this veſſel, is a part of a ſpherical ſurface, as every part of the ſea is ſo; and we ſhall ſoon ſee, that, on this ſyſtem, all things muſt appear juſt as they do; and as the ſhip is behind a very elevated part of the body of water, when the top of its maſt is at firſt ſeen, it would be juſt as natural to ſuppoſe, that, inſtead of riſing with the ſurface, it muſt cut through the convexity, as to conceive that a perſon muſt fall to the ſky becauſe his feet are oppoſite to our feet. The eye, when it is caſt over the ſea, takes in a great extent. The veſſel, when its maſt comes firſt in view at the top, is behind a great part of that convex ſurface of the ſea, which makes up a part of this extent, and, all the time that it is riſing, as it were, out of the water, the veſſel is climbing up that aſcent. This is the reaſon why the veſſel becomes only gradually ſeen, and in this manner. Nay, it is not neceſſary to have recourſe to the ſea on this occaſion, it may be, at any time, ſeen, that water is convex upon a lake or river, where the eye can be carried ſtrait and uninterrupted but two or three miles forward. Thus, if a perſon be in a boat, and can ſee another boat at the diſtance of two or three miles, (which appears but a little way upon the water) although he ſees this boat very diſtinctly as he ſtands upright, yet, if the water be perfectly ſtill, and he be down in the boat, ſo as to have his eye very near the level of the water where he is, and ſo look forward, he will not then ſee the boat, but he will find the water, in that little extent, ſwell ſo as to hide it.

There is a greater proof than all this that the earth is round, and that there is ſea in all parts of that round. We know, that, if it were a plane, the perſon, who ſhould ſet out from any one point, and go on, without ſtopping, ſtrait forward, would be continually going farther from that point from which he ſet out; but, on the contrary, that, if the earth, and the ſea with it, be a globe, by going ſtrait forward continually, at leaſt as ſtrait forward as the courſe of the ſea and land would let him, he would at length arrive at the ſame place again. Now this has been tried, and the event has anſwered to the ſyſtem of the earth's being round, for perſons, who have ſailed forward, have come, after a certain voyage, (without ever returning back) to the place from which they ſet out. The Lord Anſon, every one knows, has been round the world, that is, he has been carried in ſhips, upon the ſurface of the ſea, quite round the ſphere of the earth, though not in a ſtrait line, yet without altering the abſolute direction of his courſe: and in the ſame manner, long before, Captain Dampier, and Sir Francis Drake, and Ferdinand Magellan, had done the ſame; and the courſe, by which they did this, is marked upon the maps and globes.

Now if this be the caſe, if perſons, ſetting out from the weſt ſide of a kingdom, and ſailing directly weſtward, can, without turning

to

to the eaſt, return to the ſame kingdom on the eaſtern ſide of it; it is plain, that they have been carried round the globe of the earth; and it is plain alſo, for that was the point here, that the earth, and ſeas together, make up a maſs of a globular figure, and that there may be antipodes, ſince in ſome part of this voyage, the ſhips muſt have been in points directly, or, in ſome degree, according to the courſe of the ſeas, nearly oppoſite to that point from which they ſet out. And aſſuredly if ſhips can ſail upon a ſea with their maſts downwards, as it is called, when antipodes are ſpoken of by the unacquainted with the ſyſtem of the world, and not fall out of the ſea, or not have the ſeas together with them fall into the ſkies; men, if there had been earth in the place of thoſe parts of the ſeas, might have walked upon it without falling into the ſkies: and if it be ſo, that the ſhips were obliged to go out of their ſtrait courſe by the interpoſition of land in theſe points, then there is land oppoſite to that on which we tread; and if that land be inhabited, as no doubt but it is, then the perſons living upon it are antipodes, and their feet are oppoſite to our feet, and they are in all this imaginary danger of falling down into the ſkies.

If we go farther in the enquiry, we ſhall all the way find new proofs of this, and not one objection to it. If we examine the ſeveral appearances of the heavenly bodies in different parts of the earth, or of the ſea, we find them to be exactly ſuch, as they muſt appear, if they were ſeen from the ſeveral parts of the globe, and not as they would be if ſeen from a plane. This proves alone, that the earth is a globe, becauſe appearances muſt anſwer to the form and ſtructure of the things; but beſide this, we have another evidence, that a ſphere is the true ſhape of the earth. We know by the laws of perſpective and optics, that if any body do in all ſituations, and under all circumſtances whatſoever, caſt a circular ſhadow, that body muſt be a globe. Now in eclipſes of the moon we know, that the cauſe of the eclipſe is the ſhadow of the earth thrown upon the moon; and we find, that whatever is the ſituation of the earth at that time, or under what circumſtance ſoever thoſe eclipſes happen, the ſhadow is always circular; therefore, the body which caſts that ſhadow muſt be a globe, and it being the earth which caſts it, the earth muſt be ſo.

It is very palpable from all this, that the earth is in reality a globe; and that there are inhabitants on almoſt every part of it is certain. We find, that even the torrid zone, which the antients ſuppoſed, becauſe of its heat, to be uninhabitable, is inhabited, and is a pleaſant country; the extreme heat of the ſun being allayed by breezes and ſhowers, and even ſo far toward the north pole, as they never imagined human induſtry, or human hardineſs, would puſh its way; we find alſo inhabitants. In theſe ſeveral places, and under this general inhabitation of the globe, there muſt be continual inſtances of people who are oppoſite, or are antipodes to one another, and all thoſe things which are ſaid of them muſt be true, ſuch as their having their noon at our midnight, and the like, all which, howſoever ſtrange they appear, depend upon the general laws of the places and revolutions of the heavenly bodies, and muſt be exactly truth.

But the people who have been wavering about this belief, have this to urge in their favour, (at leaſt, in their excuſe,) that the very terms, uſed by aſtronomers themſelves, are ſuch as lead them not to ſuppoſe it. It is certain, that the aſtronomers in general are more to be blamed than any other perſons of ſcience, for the uſe of vulgar terms which they know to

to be improper and abſurd. Thus they continually ſpeak of the riſing and ſetting of the ſun and ſtars, and of the ſun's diurnal motion of revolution round the earth; whence people, who only dip into their works, have been led to believe they maintained ſuch a ſyſtem: and, in the ſame manner, they ſpeak of the upper and the lower hemiſphere, when they talk of the diviſion which the horizon makes in the ſphere of the heavens. These terms, upper and lower, may have led them to ſuppoſe, that there was a diſtinction of upper and lower, in reſpect to the ſituation of the ſkies, with regard to the earth, and may have tended, not a little, to the ſtrengthening this opinion of an upper and a lower heaven, with regard to us and the antipodes. The truth of expreſſion is this, toward the earth is, with reſpect to the inhabitants of the earth, always downward, and toward the heavens is always upward: ſo that in whatever ſituation the inhabitants of the earth are, in reſpect to one another, they would ſtill, if this proper expreſſion had been regarded, have been found in the ſame ſituation with reſpect to the earth and heavens, and the very term of falling up to the heavens, would have ſhocked thoſe who were inclined to the opinion.

The miſapplication of words in the diviſion of the heavens is unneceſſary; for there have been terms invented independent of their ſituation to deſcribe them to us, and to diſtinguiſh them from one another. The diviſion is made by the circle of the horizon, the plane of which being extended to the heavens, does divide them into two halves, or hemiſpheres, the one of which, being over our heads, is always ſeen by us, the other not, becauſe the body of the earth is between, and perfectly hides it from our view. In conſequence of this difference, the two hemiſpheres have been diſtinguiſhed by the terms viſible and inviſible, and theſe are certainly as expreſſive, and more proper than thoſe which diſtinguiſh them into upper and lower, from their relative ſituation.

ORBIS LACTEUS. A name by which ſeveral of the Latin writers have called the Via Lactea, or Milky Way, the Galaxia and Circulus Galacticus of others.

OREB. A name by which ſome, who are fond of uncommon words, call the conſtellation Corvus; it is one of its Hebrew names, and the word in that language ſignifies a raven.

ORFEREALEM. A name by which ſome call the Sagitta; it is its Turkiſh name.

ORIAS. A name given by ſome of the old writers to the conſtellation Taurus, the ſecond ſign of the zodiac. The term is of Egyptian origin, and it means Statio Hori, the Station of Horus; it regards ſome tradition of that country, and is not to be underſtood at this time.

ORION. A conſtellation of the northern hemiſphere, of great extent, and very conſpicuous in the heavens. It is named by all authors, and is one of the forty-eight old conſtellations, the knowledge of which the Greeks obtained from the Egyptians, and which all other nations have obtained from them. Orion, though of great extent, and marked, in a very fortunate manner, by the poſition of the ſtars, yet does not contain ſo large a number of them, as many which occupy a ſmaller ſpace in the heavens.

This conſtellation is in all the ſchemes of the heavens repreſented by the figure of a man, in a poſture of fighting, his left leg is lifted high, but the right ſtands firm: in his right

hand

hand he holds a club raised to give the blow, and his left is protended forwards, and has over it a lion's ſkin by way of ſhield, his head is naked, except for the hair, his body is covered; his belt is happily defined by three conſiderable ſtars, and there is affixed in it a ſhort ſword.

The conſtellations, between and among which Orion is placed, are the Unicorn, the Bull, the Whale, the Eridanus, the Great Dog, and the Hare. The Unicorn is galloping up behind him, and its horn paſſes behind the wriſt of his right hand; the Bull is in front, and a little above him; the Whale is at a diſtance, but ſtands facing him; the river Eridanus takes its origin at his left foot; the hinder part of the Hare hides his right foot, and the Great Dog is at a little diſtance below the Unicorn, and its fore feet come near the hinder part of the Hare.

The figure of Orion is naturally drawn, and he ſeems engaging with the Bull. No conſtellation in the whole heavens is more happily defined, or more eaſily diſtinguiſhed. The old aſtronomers counted thirty-eight ſtars in the conſtellation Orion; Ptolemy has ſet down that number; Tycho Brahe has often counted a ſtar or two leſs in them than theſe early obſervers, but he has, in this inſtance, added four, he makes the ſtars of Orion forty-two; Hevelius makes them ſixty-two, and Flamſtead raiſes the number to ſeventy-eight. It is not a wonder that Orion is eaſily diſtinguiſhed in the heavens; there are, in this conſtellation, no leſs than two ſtars of the firſt magnitude, and three of the ſecond, beſide a great many of the third and fourth; there are indeed fewer ſtars of the leſſer magnitudes accounted in it than almoſt in any whatever. One of the ſtars of the firſt magnitude is that upon the inſtep of his left foot about the middle, of the breadth of the Eridanus, and this is diſtinguiſhed by a particular name by ſome aſtronomers, being called *Regel*; the other is in the right ſhoulder. One of thoſe of the ſecond magnitude is in the left ſhoulder, another in the girdle at the edge, another in the middle of the girdle, or belt, as it is variouſly called, and the other, the laſt of the three, which mark that part of the habit; in all the heavens three ſtars of this ſize are not to be found together, except there. The reſt of thoſe in Orion are diſtributed pretty equally over the figure; there are ſeveral in the ſhield, a great many upon the breaſt, and ſome on each of the legs.

As to the real number of ſtars, compriſed within what we make the limit of each conſtellation, it is impoſſible to be determined; when we apply the more powerful teleſcopes we ſee the more and more of them, and this, ſo far as we know, without end. There cannot be a better inſtance of this than in the conſtellation Orion, for the ſtars of that conſtellation have been attempted, more than once, to be counted by the aſſiſtance of the moſt powerful teleſcopes. Galileo, who firſt thought of it, was diſheartened in the undertaking. By the firſt ſteps he made in it, he counted no fewer than twenty-one in the ſingle ſtar as it is called, known by the name of the nebuloſe or cloudy ſtar in Orion; and, in the ſpace between his belt and the hilt of his ſword, where our beſt figures of the conſtellations give only three or four ſtars, he counted eighty-one; and in another part of the ſame conſtellation, within the compaſs of between one and two degrees ſquare, he numbered more than five hundred. De Rheita, who ſays he went through the toil of counting all that his teleſcopes would ſhew him in this conſtellation, numbered two thouſand. It is very probable that better inſtruments would have diſcovered two thouſand more.

The

The Greeks, who have an ambition to be esteemed the first inventors of astronomy, and have adapted some part of their fabulous history to every one of the constellations, tell us, that this Orion was a son of their sea-god Neptune by Euryale, the famous huntress. The son, they say, possessed the inclinations of his mother, and became the greatest hunter in the world. Neptune gave him, they tell us, this singular privilege also, that he should walk upon the surface of the sea as well as if it were on dry land. Aristomachus is recorded to have mentioned one Hyreius in Thebes, or as Pindar places him, in the island of Cheos, who received, with great hospitality, Jupiter and Mercury, and requested of them that he might have a son. The skin of the ox, which he had sacrificed to them, was buried in the ground, they say, with certain idle ceremonies, and that the son desired was produced from it, a youth of promising spirit, and called Orion. This is the opinion more received by some as to the birth of Orion. They tell us, that he visited Chios when grown up, and ravished Penelope the daughter of Œnopron; the father, they say, put out his eyes and banished him the island; thence, they tell us, he went to Lemnos, where Vulcan received him, and gave him Cedalion for a companion. When he had been restored to sight by the sun, for that is the story, he returned to Chios, and would have revenged his injuries, but the people hid their king from him. They tell us, that, after this, he hunted with Diana, and was so exalted with his success, that he used to say he would destroy every creature on the earth. The earth, irritated at this, produced a scorpion, which stung him to death, and both he and the reptile, they say, were afterwards taken up into the skies, the Scorpion making one of the twelve signs of the zodiac.

Others, however, give a different account of his destruction; they tell us that he would have ravished the goddess of chastity, and that she killed him with her arrow. To this story Horace alludes,

> *Integræ*
> *Tentator Orion Dianæ*
> *Virginia domitus sagitta.*

So that we may suppose that the most received tradition of the time. This, however, all of the writers are not agreed about; they, who make him the sacrifice to the vengeance of the offended goddess, say, that herself afterwards placed his figure in the skies as a memorial of the attempt, and a terror to all ages; but there are some who say she loved him so well that she had thoughts of marrying him. These add, that Apollo could not bear so dishonourable an alliance for his sister, and that he killed him; and Diana, after she had shed showers of tears over his corpse, obtained of Jupiter a place for him in the heavens.

No constellation was so terrible to the mariners of the early periods as this of Orion. We find all the Greek, and all the Latin poets mentioning it. They speak of the star Arcturus, and the two Hœdi, as raising, so they understood it, storms and tempests at their rising and at their setting; but it is Orion that they always speak of with the greatest terror. We find Archytas, in Horace's beautiful ode upon the death of that celebrated mariner, calling the auster, the dux inquieti turbidus adriæ, the constant attendant on the setting of this constellation, and the cause of his shipwreck in the Illyrian sea.

> *Me quoque devexi rapidus comes Orionis*
> *Illyricis notus obruit undis.*

We find Virgil also speaking of the constella-

tion

tion in the ſame terms, and with the ſame ideas of terror. In the fourth book of the Æneid, he calls him Aquoſus Orion; and, in the firſt book, he couples him with the ſame wind under the influence of which Archytas calls him the occaſion of his death, to ſtir up that terrible ſtorm which was the great danger of his heroe:

Cum ſubito aſſurgens fluctu nimboſus Orion
In vada cæca tulit, penituſque procacibus auſtris
Perque undas ſuperante ſalo perque invia ſaxa
Diſpulit.

The hurry and rapidity of the danger from this conſtellation is kept in view by all the poets, and we find not only their epithets, but the opinions of the hiſtorians confirmed the doctrine of thoſe tempeſts, which inſtantly accompanied the riſing and ſetting of the conſtellation. When Horace would diſſuade Galatea from venturing to ſea, this is the image of terror that he calls up for that purpoſe; he ſays nothing of the rainy Hyades, nor even of Arcturus or the Hœdi, which he elſewhere names as the cauſes of terrible ſtorms, but there it is,

Sed vides quanto trepidet tumultu
Pronus Orion!

We find this poet, in all theſe paſſages, alluding to the ſetting of Orion as the cauſe of the moſt terrible tempeſts, and he purſues the ſame doctrine throughout. He never calls up this idea of a tempeſt, to which he has a mind to give a peculiar terror, but he names this conſtellation, and he always names it as pronus, devexus, ſetting; when he alarms his miſtreſs it is by the ſetting Orion, and when he prays for a ſhipwreck for a bad poet, Mævius, the circumſtance he wiſhes is, that, where this threatning conſtellation ſets, there may not be a ſingle ſtar to guide the pilot of the veſſel through the ſtorm that follows,

Nec ſidus atra nocte amicum appareat
Quis triſtis Orion cadat.

He makes the diſtreſs, that attends the ſetting of this conſtellation, with reſpect to mariners, proverbial, and as Virgil makes the ſhepherd tell his departed friend, that, while the bears love the mountains, and the fiſhes the waters, he ſhall preſerve his memory

Dum juga montis aper, fluvios dum piſcis amabit,
Dumque thymo paſcentur opes, dum rore cicadæ,
Seper honos nomenque tuum laudeſque manebunt.

Horace, in the ſame fire and ſpirit that is ſo conſpicuous throughout his odes, makes, perhaps a little raſhly, a woman promiſe her faith ſhall be as permanent as the fatal influence of this conſtellation;

Dum pecori lupus, et nautis infeſtus Orion
Turbaret hybernum mare.

It would not perhaps be proper to produce this paſſage as an inſtance of the poet's accuracy with reſpect to character, but it joins with all the reſt in ſhewing that the conſtellationwas terrible, even to the greateſt notoriety, as the occaſion of tempeſts: and ſuch abundant proof from one writer of this character, is more than the ſingle teſtimonies of a thouſand, ſlightly naming what they all joined to confirm.

As the Pleiades were called the leaders of the ſeveral northern conſtellations, (for though ſome have called them the leaders of all, the northern only were mentioned, as being guided by them, in the earlieſt writers) as

as these followed the Pleiades, the southern ones were made the attendants on Orion. Manilius names this vast constellation with an uncommon respect and veneration, as it were, on this account, and says, that, as he marches through the heavens, the starry legions of the south all follow him as their general, and wait upon his motions; and even in the capacity of the huntsman, they make the Dog, one of the most important constellations of the heavens, his attendant. There were a few, and only a few, of the constellations known to the Greeks, and these were always treated with a particular respect. This was one of them, and we find it accordingly named as of dignity and importance in almost all their writers, and from them in all the Latins.

We meet with the name of this constellation also in the scriptures, and it would be a great negligence, in a work of this kind, not to endeavour at least to explain what is meant by the word. The constellations, mentioned in the sacred writings, are very few, and they are not expressed so clearly as might be wished; nothing can be so proper as to set them right, so far as that can be done, and no place so proper as this, where the origin of the constellations is the express subject of enquiry.

To read the words as they stand in our English bibles, it should seem that there could be no difficulty about them; but this does not appear to be the case, as we enquire farther. We find Orion first mentioned in the book of Job, where that imaginary person, speaking with an holy reverence of the power and greatness of God, expresses himself by appealing to the greatest of his works, the heavens and all the host of them; *who maketh*, says he, *Arcturus, and the Pleiades, and the chambers of the south*; and in another part of that work the Creator himself is introduced speaking, and, in the enumeration of the works of his hands, naming over again the constellations, *Canst thou bind the sweet influence of the Pleiades, or loose the bands of Orion? Canst thou bring forth Mazzaroth in his season, or guide Arcturus with his sons?*

The prophets are full of this idea of the greatness of their God, and have had recourse to these images on all occasions; and they have named the same constellations on all of them. When Amos exhorts the Jews to repentance, and solicits them to apply themselves to the great God of all the universe, he has recourse to the same phrase; it is not, turn your hearts to him who created you; no, his ideas are such as shew the Almighty in a superior light: *Seek ye*, says the royal prophet, *seek him that maketh the Seven Stars and Orion, and turneth the shadow of death into morning.*

There is no doubt but in all these passages the inspired writers have meant to bid men turn their eyes to the heavens for proofs of the Majesty of the Almighty, and they concur with the psalmist, who says, *The heavens declare his glory, and the firmament his handy-work.* Neither can there be any more doubt that, by these peculiar names, which are translated the Pleiades and Orion, and the rest, meant certain constellations: but what constellations in particular they intended by them, is not so readily to be seen. The names of Arcturus, and Orion, and Pleiades, are not Hebrew; nor are they those which stand in the Hebrew copy of the sacred writings; all we see is, that the authors meant these words as names of constellations, and that the interpreters have put names also of constellations for them; but whether these are the names of those constellations intended in the Hebrew, remains to enquire.

To this purpose we are first to look into the date, so far as that can be determined, of the original writings. If we suppose the book of

Job to be written by Moses, as some pretend, it must astonish us exceedingly to find the names of any constellations at all in it: the oldest accounts we have, and the earliest origin to which we can trace the formation of any of the constellations, is but about seven hundred years before the Christian æra, (for with all the Egyptian pretensions to antiquity, their boasted early observations came to this period, and it is unwarrantable and idle to look farther) and this we must allow to be a very modern date in comparison with the time of Moses. We have no authority to support the imagination of his having written the book of Job, and we have this, among other reasons, to urge, that he did not. In all those books, which are certainly written by Moses, we find no mention of the constellations, and yet he had many occasions of naming them, had there been any formed at that time, but certainly there were not. So far from being of the same period, or nearly the same period with the books of Genesis, Exodus, and the rest, there is almost evidence that Job was written during the captivity of the Jews. The whole allegory was intended perhaps to represent their captivity, and to comfort them under it. They were flattered with having suffered without offences of their own, they were exhorted in it to put a full confidence in God; and it is for that reason that his greatness and his power are so set forth in several parts of it; and they were promised, in the conclusion, a restoration. Submission to the will of heaven was to be the means, and a state of greater affluence and prosperity, than that from which they had fallen, was to be the consequence.

This seems to be the tenor and intent of the book of Job, and this concurs with a thousand other proofs, to fix the time of its being written to that of the captivity of that people. Though it would have been very strange to have found the names of constellations in a writer of the age of Moses; yet it is not at all wonderful to meet with them in one who wrote during the Jewish captivity. The beginning of that captivity was not quite six hundred years before Christ, and we have proof that constellations were formed in the heavens, and were well known among the Babylonians, more than an hundred years before that.

It appears, therefore, that the author of the book of Job, whosoever that was, might very easily mention the names of constellations known at that time to the Babylonians, and there is no doubt but those which are translated by Orion and the Pleiades, and the rest, were such. Isaiah and Amos are the only inspired writers, who mention the constellations; they are undoubtedly earlier than the writer of the book of Job, but it is a difference, that, with respect to a comparison with the period of Moses, will amount to nothing. They tell us themselves the names of the several kings in whose reigns they prophecied, and we know the times of those reigns. They were nearly cotemporary, for they both mention the name of one sovereign under whom they prophecied. This was Uzziah, and we know that the reign of Uzziah is between seven and eight hundred years earlier than the Christian æra.

We have therefore fixed the period of those parts of the sacred writings in which the constellations are mentioned, and, instead of referring them to the improbable time of Moses, we find that two of the writers lived just about the very period in which we find the earliest mention of the constellations among the Babylonians, and the other a century and an half after; a period not much earlier than that in which we know the Greeks travelled into Egypt for the improvement of their sciences,

and,

and, among other things, brought from them the knowledge of these constellations into Greece.

Having fixed the period of these writings, we are to enquire into the names of those constellations which are mentioned in them. The two which are, in all these passages, named together, and which are translated the Pleiades, or the seven stars, and Orion, are called in the Hebrew text, Chimah and Chesil, and throughout the translation, gives the Pleiades for Chimah, and for Chesil, Orion. Our translations of the bible are from the Septuagint, or what is called the Septuagint. If we give the whole Greek version the credit of having been done by that number of wise and learned men, whom Ptolemy commanded to translate the sacred writings, still we shall have no great reason to depend upon their astronomy; for it is a science in which we have abundant proof the Hebrews of that age had very little knowledge: but there is reason to believe, that these did not translate the whole, perhaps they translated only the books of Moses, or if some other part, probably not this. If they had, it would give no sanction to their version of the names of the constellations; and if the translation of the book of Job, and of the prophecies of Amos and Isaiah, were translated by other unknown hands, we have less reason to depend upon them.

The names by which these constellations of Orion, the Pleiades, and the rest, as they stand in the several versions, are put in the original, were doubtless those by which the Egyptians, who had formed those constellations, called them; for, without doubt, the Phœnicians, and the Hebrews, and all the other people who were known to that nation, had imbibed their astronomy from them, and used their terms in the expressing the constellations. Chimah and Chesil therefore will appear to be Egyptian words, used as the names of two constellations, or of something conspicuous and determinate in the heavens; which are mentioned in the book of Job, and by the prophets Amos and Isaiah, under those names; which it was the business of those, who translated the Hebrew bible, to express, by certain other words, the signification of which was more known. It is too evident, that these translators, whosoever they were, knew not to what constellations the names were applied; they were therefore, on the best foundation that they could, to give the names of constellations which were more known, and better understood, as the explication of these; and, if they could, to fix upon those very constellations meant by them.

This was a work of hazard, but not of so great hazard as might have been imagined. It was to be done by conjecture, for certainly they had no better grounds for it, but that conjecture was not so much at large as might be thought. The constellations of the old astronomers were forty-eight in number, but it was not among all these at random that the conjecture was to be made: though so many are recorded in the old writers, that number was not formed and completed at once; men began with a few, and added to them afterwards. It was thus they were established among the Egyptians, and it was thus they were received among the Greeks; for as the Egyptian constellations were formed in a succession, the Grecian sphere received them also one after another, and at different periods.

Among those which were the earliest, we are to expect those which mankind found most useful; for it was necessity that first established them. The husbandman, who had no callendar to tell him of the seed's time, prepared

pared his ground for ſowing at the riſe of certain ſtars, and of theſe ſtars he made a conſtellation. In the ſame manner, the man who ventured out of ſight of land in his little veſſel, muſt mark the ſtars, for they alone could direct him when no other object appeared, and of theſe he made a conſtellation. The approach of a periodical ſeaſon of fair weather was marked by another ſet of ſtars, formed likewiſe into the figure of ſome animal to fix them on the memory: and the periodical return of a rainy one, was in the ſame manner marked by others. When there were two of theſe rainy ſeaſons, as we find the Jews ſpeaking of the *former* and the *latter rain*, two ſuch were formed, and thus four or five conſtellations were eſtabliſhed. Theſe being of uſe were beſt known, as they were firſt invented: the others, which were more of curioſity, were neglected by many, even after they were added.

As theſe four or five conſtellations were eſtabliſhed long before the others, among thoſe who gave origin to aſtronomy, the Greeks, in the ſame manner, were acquainted with theſe long before they knew any others. This was doubtleſs the conſideration on which the tranſlators of the bible grounded their conjecture, and it was a very rational one: and we ſhall find, that though it did not carry them abſolutely to the truth, it brought them very near it. They conſidered, that as the moſt uſeful conſtellations would be the firſt formed, ſo they would be the moſt regarded, and that both with reſpect to their utility, and to the common acquaintance of the world with them, the ſacred writers, even if they had had before them the choice of the whole forty-eight, would have ſelected theſe; at the ſame time, that they alſo conſidered it as very probable, that thoſe authors wrote at a time when no more than theſe four or five original and uſeful ones were formed.

They found in their writings the words Chimah, Cheſil, Aiſh Nabaſh, and Barih; they found it certain, that theſe were the names of four conſtellations in the heavens, and they found, that not only the ſame writer, in different parts of his book, uſed only a repetition of theſe names, and not any new ones, but that the different authors uſed the ſame. It appeared from hence alſo, that they were either the only conſtellations then known, or that they were the moſt conſiderable; and being to tranſlate them into Greek, or to give Greek words for them, they had recourſe to the earliſt Greek writers to ſee what conſtellations they were which they mentioned. Homer and Heſiod were the oldeſt writers among theſe, and, upon recourſe to them, they found that they alſo, like the ſacred writers, mentioned only four or five. There was great reaſon to ſuppoſe, as in the former caſe, that either theſe were the only conſtellations then known, or that they were the moſt uſeful; and there was all the reaſon in the world to believe alſo, that they were the ſame with thoſe mentioned in the ſcriptures, ſeeing that the Greeks were known to have obtained their knowledge of them from the very people, among whom the Hebrews had learnt them. Among the four or five names of conſtellations which the tranſlators of the Hebrew bible met with in the writings of the earlieſt Greeks, were thoſe of Pleiades and Orion, and theſe of all tho others occured the moſt frequently. They ventured to apply the four or five old Greek names of conſtellations to the four or five conſtellations mentioned in Job, and the prophets; and as the words Chimah and Cheſil occured in the bible more frequently than the other names, and the words Pleiades and Orion were, in the ſame manner, the moſt frequent among the Greeks; they adapted theſe to the

others,

others, and ventured to expreſs them by them.

Thus we always ſee the Pleiades and Orion for the Chimah and the Cheſil of the original; and throughout, the word Pleiadas is given as the verſion of Chimah, and Cheſil as that of Orion. They were ſo near the truth, that undoubtedly one of theſe two Hebrew words was the name by which they called Orion, but unfortunately it was not Cheſil.

Cheſil had another ſignification, of which in its place: and Chimah was the name by which the Hebrews called that conſtellation, which the Greeks called Orion, and which has been deſcribed in the beginning of this article.

It has been obſerved, that the Greeks very often did not underſtand the meaning of the figures they received from the Egyptians as marks of the conſtellations: among theſe there were ſeveral human forms, to which, without any knowledge of the Egyptian intent, they gave the names of ſome of their heroes, or ſome perſon famous in their hiſtory. This was the caſe with their Caſtor and Pollux, perſons of whom the Egyptians, who contrived the ſign Gemini, could have no knowledge, and ſo of the reſt. The Perſeus, the Cepheus, and other ſuch names, given to the human forms among the conſtellations, were no part of the characters of theſe conſtellations among the people who deviſed them, but were added by theſe Greeks out of an ambition to have the ſcience ſuppoſed of their origin. Thus the figure of a man kneeling, which they received without any account of what it meant from the Egyptians, they called Hercules.

Among the enthuſiaſtical reformers of the conſtellations, Orion has obtained two new names. Schiller calls it St. Joſeph, and Schickard Joſhua; but few pay any regard to them.

ORNIS, *the Bird.* One of the northern conſtellations, the ſame that is uſually called the Swan. *For its ſituation, hiſtory, and number of ſtars, ſee* CYGNUS.

ORPHEUS. One of the northern conſtellations, the ſame that we uſually call Hercules; and that the old Greeks and Ptolemy call only Engonaſin. They have ſuppoſed it Orpheus, by the Harp which is juſt before him, and to explain the kneeling poſture, imagine him petitioning the bacchanals for his life. They received this conſtellation, as the others in general, from the Egyptians, and not knowing what that people meant by a man upon his knees, (probably only an emblem of devotion,) they have adapted theſe, and many other names to it. *See the article* HERCULES.

ORPHYS. A name by which ſome, who are fond of uncommon words, have called the conſtellation Cetus; it is one of the old Greek names for that ſign.

ORSILOCHUS. A name by which many of the old writers have called the conſtellation more generally known by the name of Auriga. It is pretended by the Greeks, that an Argean of this name was raiſed up into the ſkies for being the inventor of coaches, and that the bridle in his hand expreſſes as much. This is robbing the ſon of Vulcan, Erichthonius, of the honour of that invention; but the conſtellation ſeems to belong juſt as much to one of theſe as the other. It is only a countryman carrying home a teeming goat. *See* AURIGA.

ORUS. A name by which ſome of the aſtronomical writers have called the Sun.

OSIRIS.

OSIRIS, *Star of.* A name by which we find the planet Jupiter mentioned by those who have written of the Egyptian astronomy, when they speak of the star of Isis, they mean Venus.

OSTRICH's NEST. A name by which some, who take all occasions of using uncommon words, call the constellation Corona Australis, the Southern Crown. There is something among the astronomical authors to authorise this. The Arabic authors call this constellation Az'ha Al Naam, the literal translation is, the Nest of the Ostriches. There is not any constellation in the whole heavens that has been represented under such a variety of forms, or called by such a variety of names as this. Some call it a crown, and some a garland, some a wheel, Rota Ixionis, and some the Caduceus of Mercury, some a tortoise, and others the nest of a bird; and there is no doubt but that it has, at one time, or other, been represented in the schemes of the heavens in every one of these forms. The Arabs, who first called it an Ostrich's Nest, call two stars, not very distant in the leg of Sagittary, Al Naaim, which some have rendered two Ostriches, but there are others who say the term means cattle, and of this number is so considerable a writer as Dr. Hyde.

OUNCE. A name given by some of the astronomical writers of our own country, to one of the new constellations which Hevelius added to the northern hemisphere: but it is better and more customary to call it by its name, as originally given, the Lynx. It stands immediately before the Little Lion, and the Great Bear, and contains, according to the account of Hevelius who formed it, nineteen stars; but the discerning eye of Flamstead has raised the number to forty. *See the article* Lynx.

P.

PAKIZA. A name by which ſome fanciful people call the ſign Virgo.

PALILICIUM. A name by which the Roman authors have called the bright ſtar in the Bull's eye, called alſo Aldebaran. The feaſt-day of Pales was that of the riſing of this ſtar.

PARABOLA. A figure made by the cutting through a cone with a plane that is parallel to one of its ſides. This is one of the regular conic ſections.

PARADISE, *Bird of*. A name of one of the new conſtellations in the ſouthern hemiſphere, called alſo Paradiſæa and Avis Paradiſi, and Apus; it reaches from the Southern Triangle to the Chamelion, and contains eleven ſtars. *See the article* Apus.

PARALLAX. The difference between the apparent ſituation of a ſtar viewed from the centre of the earth, and of that ſtar viewed from any part of the ſurface of the earth, is called the parallax of that ſtar. Aſtronomy lies under many difficulties beſide thoſe which appear to a common eye, and this matter of the parallax of the ſtars is one. When we look at any ſtar in the heavens, we do not ſee it in its real place, the rays coming from it when they paſs out of the purer medium, the æther, into that coarſer and more denſe one, our atmoſphere, are refracted, or bent in ſuch a manner, that they ſhew the ſtar higher than it is. We thus ſee all the ſtars before they riſe, and after they ſet, and we never ſee any in its true place in the heavens. But, beſide this, there are thoſe differences ariſe from the different directions in which we ſee them.

In aſtronomical obſervations, we look upon all the movements of the heavenly bodies as if they were real revolutions round the centre of the earth; and it is with reſpect to that centre that we eſtabliſh the true ſituation of the ſtars. In the mean time, being placed, as we are, upon the ſurface of the earth, every obſerver ſees each of thoſe ſtars anſwer to a different part of the heavens, according to the place where he ſtands to make the obſervation, and the different elevation of thoſe ſtars above the horizon. This difference, between what would be the ſtars place in the heavens, if viewed from the centre of the earth, and what is ſo as it is viewed from ſome part of its ſurface, is, as has been already obſerved, the parallax of the ſtar; and it follows, that the parallax of the ſame ſtar, ſeen at the horizon, is the greateſt that it poſſibly can be, and that it diminiſhes continually according to the different heights above the horizon, according to the proportion of the ſinus's of the complement of its apparent height. This is the general fact, but, to determine what is exactly the quantity

of the parallax in any given height, astronomers have many different inventions; the most familiar of them all is this.

Let there be two observers placed as far as may be from one another, but upon the same meridian, their distance being limitted only by this, that they are in such places that they may both see the star they are to make the object of their observations above their horizon. Each of these observers in his post is to take the height of this star at passage over the meridian, and he is to correct this according to the rules laid down with regard to refractions, in order to have its true meridian altitude, the complement of which is its distance from the zenith. When this is done, he is to find the height of the pole for the place where he has made his observation, the complement of which is the distance of the pole from the zenith, and this, being compared with the distance of the star from the zenith, gives the distance of the star from the pole for the place where each made the observation.

The difference between this distance gives the measure of the parallax of the star viewed from these two different places. From these it will be easy to deduce its horizontal parallax, making it as the sum of the sinus of the complement of the distance of that star from the zenith, with regard to the two different observers, when that star was found on the one side and on the other of the zenith; or, it will be as the differences between these sinus's, when the star is in the same respect to the zenith, as to the total sinus; as the one of these is to the other, so will be the parallax observed in comparison with the horizontal parallax.

On the principle of this admeasurement also, taking advantage of the proper opportunities, the observer will find the horizontal parallax of any of the planets, and their distance from the earth, on the foundation of first knowing their distance with regard to that between the earth and the sun.

PARALLEL. The antients, who, before the method of setting down the latitudes of places in degrees and minutes was invented, used to divide the surface of the globe, so far as it was known to them, into what they called climates, and, to account by what they called the beginning, the middle, and the end of the climate, sometimes use the word parallel, as a term of measure expressing half of what they called a climate.

A climate was a space of the globe comprehended between two parallels north of the equator, the one of which, (that nearest the equator) was called the beginning, and the other, (or that farthest from it) the end of the climate, and which were so far distant from one another, that the difference of length, in the longest day of one and of the other, was half an hour. When they spoke thus, they meant, by the term parallel, as we do at this time, only a linear circle, but, when we find them mentioning a parallel as the name of a measure, they always mean by it the measure of half a climate, that is, an extent of the surface of the earth north of the equator, the longest day at the one extremity and at the other of which space, differed a quarter of an hour.

PARALLELS. Among the number of the parallels to the equator we are to reckon two, which are distinguished by peculiar names, and which serve to divide the heavens into portions. These are the arctic and the antarctic circles, or, in plainer words, the north polar circle, and the south polar circle. In whatsoever place of northern latitude we are, the largest parallel, which appears entire above the horizon of that place, is the arctic circle according to the use of that term among the antient astronomers;

mers; and in the ſpace contained between this circle and the north pole, are comprehended a number of ſtars which never ſet, but are carried about round the pole in circles parallel to the equator, but in all their parts above the horizon. This is plain from the ſituation of thoſe ſtars, for the arctic circle being itſelf a parallel in every part above the horizon, all thoſe parallels, which paſs through the points of the heaven in which ſtand the ſtars that are above that circle, being in two parts, like that circle, parallel to the equator, muſt be in all parts above the horizon, and conſequently thoſe ſtars, which are there, cannot, at any time, ſet.

In the ſame manner, the largeſt parallel, which is, to that place, hid beneath the horizon entirely, is called, by the old aſtronomers, the antarctic circle of that place. In this are contained all thoſe ſtars which are carried round the pole at all times in circles parallel to the equator, and compriſed within that circle; ſo that, in reſpect of their revolution, they never appear above the horizon of that place. It was for this reaſon that the old writers have alſo called the arctic circle, circulus ſemper apparentium, the circle of the ſtars which always appeared; and the antarctic circle, the circulus maximus ſemper occultorum, or greateſt circle of the ſtars which were always hidden; and others of them have called the one the circle of perpetual apparition, and the other the circle of perpetual occultation.

We ſhall ſee from this account of the arctic and antarctic circle, that, to a perſon who ſhould live at one of the poles, the equator would ſtand in the place of both of them, and would be, in effect, the arctic and the antarctic circle of that place; for, in this caſe, the equator is coincident with the horizon, and conſequently all the parallels on one ſide of the equator would be perpetually in ſight, and all the parallels on the other ſide perpetually hidden; ſo that the ſame circle would mark the limits of both, and would be at once the circle of perpetual apparition, and the circle of perpetual occultation. Thoſe who live at the poles, from having the equator thus parallel to the horizon, or coincident with it, are ſaid to live in a parallel ſphere, as thoſe, who have the equator and its parallels (ſo many of them as are ſeen) cutting the horizon obliquely, are ſaid to live in an oblique ſphere; and thoſe, who have the equator and all its parrallels cutting the horizon at right angles, are ſaid to live in a right ſphere. This laſt is the ſituation of thoſe who live under the equator, and the former, of thoſe who live any where between the equator and the poles, that is, in a manner of all people in the world. It is hence that we are accuſtomed to conſider the heavens in the light of an oblique ſphere, and that we, of all things, are firſt to comprehend what the oblique ſphere is, in order to underſtand any thing in aſtronomy.

If we place ourſelves in a right ſphere, we ſhall ſee every ſtar riſe at right angles in the eaſt part of the horizon, and from this point we ſhall ſee it aſcend gradually all the way of its courſe till it comes to the meridian, when, being at the higheſt, it from thence deſcends gradually in the ſame manner as it had aſcended, going all the way lower and lower till it comes to the weſtern part of the horizon, where it ſets at right angles as it roſe. This is the courſe of its parallel, and from the doctrine of parallels, already laid down, it is clear that nothing but this could happen.

Parallels, *or* Parallel Circles. Circles which the ſtars ſeem to deſcribe in the heavens by their apparent diurnal revolutions about the pole. They have this name at whatever diſtance from the pole. *See* Circles.

Parallel Circles *to the Horizon.* A term uſed by ſome, (and it were to be wiſhed that it was uſed by all) to expreſs what are more generally called almicantarahs, circles conceived to be drawn parallel to the horizon, and at any height between that and the zenith. Theſe will be large as they are near the horizon, and ſmall as they are neareſt to the zenith, or, ſpeaking of the lower hemiſphere, to the nadir. The term, parallel circles, would be uſeful, becauſe it would expreſs what they are, and could not be forgotten. The other is an affected word.

Parallel Lines. Two lines are parallel when they are in every part at equal diſtances from one another. If it be neceſſary to try whether they be parallel, the ſpace between them is to be meaſured by other lines drawn from ſeveral parts in a perpendicular direction, and continued from one of them to the other. If it appear, by meaſuring, that theſe perpendicular lines are all of the ſame length, then the two others are truly parallel to one another; if there be any difference in the length of the latter, the former cannot be parallel. It is plain from this, that parallel lines, if we ſuppoſe them continued to ever ſo immenſe a diſtance in the ſame direction, can never meet; be their ſpace ever ſo ſmall, it will continue to the end of their extent, ſuch as it was at firſt, and they will be always, and in all parts of their courſe, equidiſtant from one another.

A ſtrait line, drawn acroſs two parallel lines, in whatſoever direction, will have the ſame inclination with regard to both. This is a conſequence of its being a ſtrait line, and their being parallels; if it be perpendicular to the one, it will be alſo perpendicular to the other; if it be oblique to the one, it will have the ſame obliquity with regard to the other; in conſequence the angles formed by it with the one will be equal to the angle which it forms with the other. This muſt be the caſe, ſince it preſerves its direction without bending, and they are fixed in their places in the ſame direction. The ſtrait line, in cutting theſe two parallel lines, forms eight angles, four with each line, two being above, and two under the line. The two of theſe that are below the upper parallel line, and the two which are above the lower parallel line, are called the internal angles in ſuch a figure; and the two which are above the upper parallel line, and the two which are below the lower, are called external. Of theſe the right hand of the upper, and the left hand of the lower internal angles, are called alternate, as are alſo the upper right and the lower left. The left hand external upper angle, and the left hand internal lower angle, are, when conſidered together, called *oppoſite angles on the ſame ſide*, and ſo are the right hand upper external angle, and the right hand lower internal. The upper left hand internal angle, and the lower left hand internal angle, are called the internal angles on the ſame ſide, and ſo are thoſe on the right denominated. Among theſe the alternate angles are equal, and the internal angles on the ſame ſide are equal to two right ones.

Parallel Sphere. A term uſed by aſtronomers to expreſs what would be the ſituation of the ſeveral great circles of the earth to a perſon who lived at one of its poles, as he, who lives under the equator, and has the celeſtial equator, and all the parallels, cutting the horizon at right angles, is therefore ſaid to live in a right ſphere, or to have a right horizon; and as a perſon who lives, (as almoſt all the inhabitants of the earth do) in a part of the earth between the equator and one of the poles, and who has, from this ſituation, an oblique horizon,

horizon, or has the equator interfecting his horizon obliquely, is faid to live in an oblique fphere. So the perfon, who lives at one of the poles, having, in confequence of that fituation, the poles of the heavens, one in his zenith, and the other in his nadir, and having the equator confequently coincident with the horizon, and all the parallels parallel to it, is faid to live in a parallel fphere, or to have a parallel horizon.

PARALLELOGRAM. A quadrilateral figure, which has its oppofite fides parallel. *See* QUADRILATERAL.

PARTHENOS. A name by which fome of the old aftronomers have called the conftellation Virgo.

PASCHAL LAMB. A name given by Schiller to the Little Dog. *See* CANIS MINOR.

PASSER. A name given by fome to the conftellation of the fouthern hemifphere, more generally known by the name of the Flying Fifh. *See the article* PISCIS VOLANS.

PASSER MARINUS. A name by which thofe, who affect to have new names for every thing, call the Pifcis Volans, or Flying Fifh, one of the new conftellations of the fouthern hemifphere. This is an unluckily chofen innovation, for Paffer Marinus is not a name of this Flying Fifh, Paffer, applied to a fifh, fignifying a very different one, a plaife; the Flying Fifh has been called by the name of fome of the birds, as the Kite and the Swallow, Hirundo, and Milvus, but never by that of the Sparrow, till by their nick names of the conftellations, who feem to think a multiplicity of terms the ornament of a fcience.

PATELLA. A conftellation offered to the aftronomical world, and compofed of a little clufter of very confpicuous unformed ftars, near the right fhoulder of Ophiucus.

The creature, under the out-lines of whofe figure thefe are difpofed, is the common Limpet, a fhell-fifh, frequent about our rocks, and very familiarly known to all who have at all confidered that part of the animal creation; it is placed with its opening, or broad part, oppofite to the fhoulder of Ophiucus.

The Patella is a fmall conftellation, and contains only a few ftars; their exact place and fituation may be feen in its figure given with that of Ophiucus.

The conftellations, between which it is fituated, are Ophiucus, the Serpent, and the Eagle; but it is more diftant from the two latter, and its fituation is fufficiently afcertained with refpect to the former only. The ftars of which it is compofed are eafily counted, for, they are only four, but they are all large and beautiful ones; three of thefe which are difpofed almoft in a line, mark the bottom of the fhell, and one which ftands fingle over them, the top.

PATERA. A name by which fome, who are fond of uncommon words, have called the conftellation Crater; it is a name by which we find it called in fome of the old poets.

PATHOS. A name by which fome of the antient writers, and from them fome of the modern ones, have expreffed that peculiar appearance which we call twinkling in the fixed ftars, and which diftinguifhes them from the planets. The old writers were very much puzzled to account for this. Ariftotle fays, it is owing to their diftance, in confequence of which their light comes but weakly, and interruptedly to our eyes; but thofe who will

will look upon Syrius the bright ſtar in Lyra, and indeed upon any of the others of the larger kind, will find this by no means the caſe, for far from being fainter, their light is much more ſtrong and vivid than that of the planets.

We are to conſider, in order to underſtand this difference in the appearance of the fixed ſtars and planets, what is their real difference in themſelves; we ſhall find, that the fixed ſtars are bodies of fire, ſhining with their own light, as the ſun does, and we ſhall find, that the planets are opake bodies, globes of earth, or of ſome other unluminous materials, which only reflect to us the light which they receive from the ſun, and ſhining but with a borrowed brightneſs, can have nothing of that fiery radiance which muſt be ſeen in the others. We cannot have a more familiar inſtance of this difference, than in the different light of the ſun and moon, the one a body of fire, all bright and dazzling, the other a globe of earth, though tranſmitting to us a very bright light, yet having it calm and ſteady. The ſtars are ſuns, the planets are moons; this is the ſtrict truth, and where then is the wonder, that the one ſhould blaze, and the other only ſhine, though they are both at ſo great diſtance in reſpect to the ſun and moon? for as they poſſeſs the diſtinct qualities of theſe luminares, they muſt exert them.

There have been ſome who have advanced, that this twinkling of the fixed ſtars is owing to their inſtantaneous appearing and diſappearing; for they ſay, their diameters are ſo extremely ſmall, that every particle of floating duſt intercepts them, but the other has the more face of probability.

PAUL, *or* ST. PAUL. A name, according to ſome, of one of the northern conſtellations. It is the name which Schiller has given to the Perſeus of the Grecian ſphere.

PAUL AND THE VIPER. A name given by Schickard, and ſome of his followers, to the conſtellation Ophiucus, or Serpentary; this is as extravagant a thought as ever came into the heads of all theſe menders of the ſphere. That a ſerpent of ſo enormous a length ſhould have been hid among the billets, thrown upon the fire unſeen, and afterwards be ſhaken from a man's finger, is monſtrous and abhorrent to common appearances; but what will not theſe gentlemen do to make every thing a ſcripture ſtory in the heavens. Schiller, who never ſtops at altering the figures, new models the conſtellation, and turns the ſerpent into a furze-buſh; he then calls it St. Benedict among the Thorns. *See the article* OPHIUCUS.

PAVO, *the Peacock*. One of the conſtellations of the ſouthern hemiſphere; it is not one of the forty-eight old ones, but of thoſe which have been added by the late aſtronomers. It is not a large conſtellation, nor does it contain a quantity of ſtars more than proportioned to the ſpace of the heavens which it occupies; but theſe are ſome of them conſiderable enough to be very conſpicuous, and they are, in general, ſo diſpoſed as to mark the out-line of the figure very happily, and be well diſtinguiſhed in the ſphere.

The Peacock is repreſented ſtanding with its head erect, its wings cloſed, and its tail not ſpread, as is ſometimes the caſe with peacocks, but carried ſtrait from the body in a tolerable length.

The conſtellations, between and among which the Peacock is placed, are the Indian, the Altar, the Southern Triangle, and the Bird of Paradiſe; theſe are all very near it. At a greater diſtance are Sagittary and the Hydrus, but it, in ſome reſpect, ſtands between theſe; it ſtands before the Indian, its

breaſt covers the lower part of his figure, his thighs, and a part of his waiſt: Sagittary is over its head, the head of the Peacock being againſt a part of its belly, the Altar, with its ſmoke, are very near the tail of this conſtellation, as are alſo one part of the Triangle, and the head of the Bird of Paradiſe: the tail of the Hydrus reaches juſt to the feet, but the greater part of its figure is at a conſiderable diſtance from it.

The Peacock is very naturally drawn; this indeed is an advantage the new conſtellations have in general over the old ones. The ſtars which are counted in it are fourteen, and they are diſtributed very equally over the figure; there is a ſingle large ſtar in the head, which may very well ſtand for the eye; there are three conſiderable ones, almoſt in a line, one on the breaſt, another on the top of the wing, and another on the back; the two firſt of theſe, if we ſuppoſe the figure of the Indian continued when it is carried behind this bird, would fall one upon the right, and the other on the left thigh, there is one juſt by the thigh of the Peacock, and one juſt under the body, at the inſertion of the tail, but theſe are rather out of the line of the figure, and there is one between the feet of this bird, but that may be ſuppoſed to be in the tip of the tail of the Hydrus. There are ſeven or eight in the tail of the Peacock, very well diſpoſed, according to the out-line of that figure. Theſe together render the Peacock a conſtellation as well defined as any in the heavens.

PAVONES, *the Peacocks.* One of the Arabian conſtellations; it is the figure of two Peacocks, and ſtands in the place of Gemini. Thoſe people, by their laws, being forbidden to draw human figures.

PECUDES. A name by which ſome have called a cluſter of ſtars upon the hands of Cepheus. It is of Arabic origin; for the aſtronomers of that nation call theſe ſtars Al Agh'nam, Sheep. They alſo call the bright ſtar in his foot Al Rai Paſtor, and that between his feet Al Kelb, the Dog; ſo that here is the Flock, the Shepherd, and his Cur.

PEGASUS, *the Horſe.* One of the conſtellations of the northern hemiſphere, mentioned by the antient aſtronomers, and one of the old forty-eight which we have from the Greeks, and which they probably received from the Egyptians. It is a conſtellation of great bigneſs, and though ſtars are to be ſeen, more or leſs, in every part of it, it is not ſo full as many others, nor does contain ſo many as ſome others of leſs extent in the heavens.

The Equuleus, which ſtands immediately before the head of Pegaſus, is only a ſection, or part of a figure; it repreſents no more than the head and neck of a horſe, and even Pegaſus, though a conſtellation of ſuch conſiderable extent, is not a complete animal; it is repreſented in the ſchemes of the heavens as only the anterior half of an horſe with wings upon the ſhoulders; the figure conſiſts of the head, neck, fore legs, and half, or more than half the body, but none of the hinder part is ſeen, the ſtars that would have fallen into it being taken up by Andromeda, Piſces, and ſome other conſtellations. Pegaſus is at a very conſiderable diſtance from the pole; its ſituation is between the Fiſhes, Andromeda, the Lizard, the Swan, the Fox and Gooſe, the Dolphin, and Equuleus. The laſt five of which, put together, will not make up the extent of this ſingle conſtellation. The Southern Fiſh is over his back, and Andromeda is under his belly, the Lizard is at a ſmall diſtance under his fore feet, the Swan

is before them; the tail of the Fox comes very near the hoof of the right foot; the Dolphin is opposite to his nose, and the Equuleus seems to grow from the front of his head. It is tolerably regular in figure of thus much of an horse, but the wings are small in proportion to the bulk of the body; and the legs are also usually drawn shorter than they should be.

The antients counted twenty stars in the constellation Pegasus; Ptolemy has set down so many, and we know that he was a faithful follower of Hipparchus, who made the first catalogue that ever was drawn of the fixed stars. Tycho reduced the number by a single star, but Hevelius greatly enlarged it, he has set down thirty-eight stars in Pegasus, and our discerning Flamstead has raised the number to eighty-nine; of these several are of considerable size, and these are distributed over almost all parts of the figure, but especially the fore part. There are no fewer than four stars of the second magnitude in Pegasus, which is a very considerable account for one constellation; one of these is in the rise of the hinder leg, and another in the shoulder, or point of the insertion of the wing; a third of them is in the lower part of the belly of Pegasus, just at the head of Andromeda; and the fourth is near the tip of the wing. The rest are principally of the fifth and sixth magnitudes, for there are but few of the fourth, and yet fewer of the third. Two of the larger of these are in the face of the Horse, one in the neck, two others on the breast, and four or five in the two legs: there are some tolerably large about the wing, but those of the body are, in general, small.

The Greeks could not find a flying horse among the constellations which they had learned from the Egyptians, without immediately fathering upon it the story of their own monster of this form. Indeed it is a question, whether they did receive a flying horse among these at all. The wings are not very necessary to the figure, for the use of comprehending stars, for they rise but a little above the back, and there are no considerable stars above it. They, very probably, received no other than the fore part of an horse from the Egyptians, but added wings by way of making it considerable, and the occasion of a good story.

They tell us, that Pegasus, a famous horse with wings, recorded in their story, was the offspring of an amour between Neptune and the gorgon Medusa, (for their gods were as whimsical as our mortals in their taste) and this was the famous horse, that, with a stroke of his feet, opened a fountain in Mount Helicon, which, from its origin from this accident, was called Hippocrene.

Others tell us, that when Bellerophon came to Prætus, the son of Abas, the king of the Argives, Antia, the wife of that monarch, fell in love with her guest, and offered him a part of the kingdom if he would comply with the dictates of her passion. The youth refused, she accused him to her husband, and he sent him to one who exposed him to destruction by the famous chimera; the horse on which he rode to the attack was this winged Pegasus, and, after the conquest of the savage, he would have raised the victor into heaven. They tell us, Bellerophon fell off by the way, but that the creature made good its journey, and remains, at this time, among the stars. Others take this horse to be a mare, and talk of a nymph converted into this form. They give also, on this foundation, a most notable account of our seeing only one half of the animal; for, they say, she hides the hinder part from the Centaur in the same hemisphere, whom they make to be Chiron, and that she will not let him see she is a female.

Among

PEGASUS. Among the religious reformers of the constellations, we hear of this under very different names and figures. Hartsdorf, who goes back to the Old Testament always for his allusions, makes it to be the king of Babylon mentioned by Jeremiah; and Schiller has raised it into the angel Gabriel. Some have called it Lucifer and Gabriel.

PENCIL *of Rays*. There are rays of light going off every way from any point of a visible object. Those of these rays, which, coming from one such point, fall upon the surface of a lens, and, passing through it, are connected together in a point behind it, are called a pencil of rays. The whole pencil, thus considered, consists therefore of two cones, applied to one another, base to base, and the section of the lens is the plane where they thus meet. The vertex behind the lens is called the tip of the pencil, the other is called the radiating point of the object.

PERIÆCI. One of the terms by which the antients expressed the situation of places on the globe, by their return and duration of seasons with respect to one another. They used this term Periæci in two senses, not different from one another, but only more or less extensive. The general acceptation of the word was, that it expressed people who lived upon the same parallel, but opposite to one another, or on opposite points of this parallel; the consequence of this would be, that they would have the same seasons of the year all alike, and at the same time; and the heavenly bodies, (the sun among the rest) would be seen to come to their meridians, and to rise and set in the same portions of time, but at exactly opposite hours, so that it would be noon at one of the places, when it would be midnight at the other. The rising and setting of the heavenly bodies in the same manner, would necessarily arise from their having the same elevation of the pole, and both a like horizon; but the contrariety of time, or our marking it midnight at one, when it was noon at the other, would as necessarily follow from their being opposite; since, having but one sun to cause the day to both, he must be the most lost to the one, when he shone the most strongly on the other.

This is the particular sense of the word Periæci, and, being the most striking, it was the most frequently used in this; but the antients also extended it to signify, not only those who lived in places opposite to one another in the same parallel, but to those who lived at any distance on the same, or in any different parts of the same circle. The seasons of the year are alike to all these, as they are to those who live in the opposite points, but their day and night are not exactly at contrary hours, but only at different ones, and those are different in proportion to their distance from one another, or, as they approached more or less toward being opposites.

PERIGEE AND APOGEE *of the Sun*. After we have considered the figure of that orbit which the sun describes by his proper motion, it is necessary to fix the position of that orbit in the heavens; that is, we are to determine the points of the ecliptic to which the apogee and perigee of the sun answer. These are at the extremity of the great diameter, which passes through the centre of its orbit, and the centre of the earth, as also at the extremity of that orbit, and the sun's greatest equation. There have been many methods proposed for determining the apogee and perigee of the sun, the excentricity of its orbit, and its greatest equation. These are founded on the several different hypotheses that have

 been

been eſtabliſhed, and require a very perfect knowledge of thoſe to which they belong, or on which they depend. In the uncertainty of this, and the trouble of acquiring the prior knowledge, may it not be well to propoſe a method of determining the apogee and perigee of the ſun, and, at the ſame time, fixing the aphelia and perihelia of the planets, the excentricity of their orbits, and their greateſt equation, according to which none of theſe hypotheſes is neceſſary; but to the underſtanding and executing of which, it is only neceſſary, that we allow the true motion of the planet from its aphelium to its perihelium, to be like that which has been obſerved in its going from its perihelium to its aphelium in its contrary direction. Let us ſuppoſe, a circle, or an ellipſis, or any other curve, be it what it will, to repreſent the orbit of the ſun, or of any of the planets; let us ſuppoſe the globe of the earth, fixed in any point of the diameter, or axis of this curve, which diameter, or axis, paſſes through the points of the apogee and perigee.

If we ſuppoſe the ſun, or planet, runs round that orbit, with all the degrees of ſwiftneſs, which it really has, in ſuch a manner, however, that two given arcs be like; and let its motion in one part of its orbit be ſimiliar to its motion in the other, it is evident, that when the planet is in its apogee, we ſhall ſee it paſs through all the degrees of its inequalities, till it be arrived at its mean time, in which place its equation will be as great as it poſſibly can be any where. From this point, in purſuing its courſe in the orbit, its equation will diminiſh till it has arrived at its perihelium, where the inequality will entirely ceaſe. After this, as the planet will continue in its courſe, its inequalities will appear again a-new, in the very ſame manner, as they had before encreaſed, or diminiſhed; and thus they will continue varrying till the planet has returned to its aphelium, where its true place will coincide with its mean place.

It follows from this, that if the planet be ſeen at firſt in its mean diſtanees, after it ſhall have compaſſed the half of its revolution, as it has afterwards changed place, the true motion will be meaſured by the angle it has then made, and its mean by the other, more the former, and the difference of theſe will be the double of its greateſt equation; from this the reſt will follow, and no way will be found more certain, or more familiar.

PERISCII. A term uſed by ſome of the old aſtronomers to diſtinguiſh the inhabitants of certain parts of the earth by the place of their ſhadows at noon. As the ſun always bears the ſame reſpect to the ſeveral parts of the earth without the tropics, and is annually ſubject to the ſame changes with reſpect to the places within them, theſe terms, while they conveyed ſomething of aſtronomy, at the ſame time determined very fairly the ſituation of the places. There are ſeveral of theſe terms derived from the place of the ſhadows at noon, and anſwering the ſame purpoſe of aſcertaining the place of the globe, inhabited by the people to whom they belong. Thus the term amphiſcii, or thoſe who have their ſhadows at noon, ſometimes to the north, ſometimes to the ſouth, can mean only ſuch, as living in the torrid zone, or between the tropics, have the ſun ſometimes to the north, and ſometimes to the ſouth of them at noon; as he advances toward them from the equator, or is got beyond them toward the tropic, and the ſame with reſpect to his return: on the other hand, thoſe who live without the tropics, having the ſun always in one reſpect to them, as he never goes beyond, or indeed comes up to them, have conſequently their ſhadows always one

one way, and these are called heteroscii; the term comprehending equally those who living to the north of the tropic of Cancer, as we of Europe, have the sun always to the south, and consequently the shadow always north at noon; and those, who, living to the south of the tropic of Capricorn, have the sun always north at noon, and consequently have their shadows always south. Having explained these, the word Periscii will be easily understood: the sense of the term is, such people as have their shadow every way round about them.

To understand this, we are to observe, that as any place is situated farther from the equator, the longest day is in proportion longer. Now when we arrive at such a distance that the longest day is more than twenty-four hours, the sun being carried round without setting, or sinking beneath the horizon, their shadows, at that time, in the several parts of the day, change place and direction continually, till between the morning and the night of this longest day, they having one quite round them. Those people are therefore, for that time of the year, in which their day is more than twenty-four hours in length, called Periscii.

It will be understood, that people became Periscii by living toward the pole; and it follows, that the nearer they live to the pole, for the longest space of time, they will be Periscii. At the poles the day is six months, and consequently, if there be any inhabitants at the poles, they are Priscii for six months together.

PERPENDICULAR. A column that stands upright upon a plane, or a strait line that stands upright upon a plane surface, is said to be perpendicular to that plane. A line is then perpendicular to a plane, when it makes right angles with all the lines which can be drawn upon the plane, through the point on which it stands. If a strait line stands obliquely upon a plane, or a column leans upon a pavement, the line is said to be inclined to the plane, and the acute angle contained between the line and the plane, when they approach nearest to one another, is the angle of the line's inclination. When a strait line is placed about a plane in such a manner that it no where touches it, but is in all parts at an equal distance, it is called a line parallel to the plane. These are the great relations of strait lines to planes. *See* PLANES.

PERPENDICULAR *to a Sphere*. Any line is perpendicular to a sphere which can be supposed formed, by continuing the line, which makes its diameter out beyond the surface. The term means no more than a line, which stands upright upon the outer or inner surface of a sphere. *See* SPHERE.

PERSEUS. A constellation, and a very considerable one, in the northern hemisphere. It is not at a very great distance from the north pole, and is one of the forty-eight old constellations, of which all the astronomical writers speak. It is of great extent, and comprehends a great number of stars.

It is the figure of a man without armour, or any covering, except a loose robe above his middle, but with a helmet on his head, and having in his right hand a sword, and in his left the gorgon's head.

Perseus is placed between Cassiopeia, Andromeda, the Triangle, Taurus, the Camelopardal, and Auriga. Cassiopeia is over his head; the sword in his right hand comes very near to her arm; the feet of Andromeda are also over his head, and the right near his sword; the Triangle is at his back, and near the head of Medusa; his left foot comes very

near the back of the Bull, his right foot meets the left knee of Auriga, and the hinder feet of the Camelopardal come toward that knee.

Perſeus is a conſtellation of extent, and it comprehends a proportioned number of ſtars. The catalogues of the old writers allow twenty-nine to it, we find ſo many ſet down in Ptolemy, and he followed Hipparchus with a religious ſtrictneſs; Tycho admits the ſame number, but Hevelius raiſes it to forty-ſix, and Flamſtead has given the magnitudes and places of no leſs than fifty-nine ſtars which he counted in it. Of theſe there is one allowedly of the ſecond magnitude in the ſide, and another, which ſome call of the ſecond, and others only of the third magnitude, called the lucid one, in the head of Meduſa. Theſe ſizes are very arbitrary. There are ſeveral of the third, and more of the fourth magnitude. Upon the whole, the conſtellation Perſeus, although it have not one ſtar of the firſt magnitude, has more of the larger kinds in general than any of thoſe about it; and theſe are diſpoſed tolerably regularly. In the ſword there is only one of any conſiderable ſize, the arms have principally ſmall ones, the body and legs ſhew ſeveral large ſtars, and there are ſome on the face, and four very conſiderable ones in the head of Meduſa, beſide a conſiderable unformed one. One of theſe is on the fore-head, one near each eye, and the other toward the mouth; the unformed one is near the cheek on the left ſide.

The ſword of Perſeus has ſo little to do with the buſineſs of the ſtars contained in that conſtellation, that it is very probably an addition made to the figure by the Greeks, to adapt it to their hiſtory, and very poſſibly the head of Meduſa was no part of the original conſtellation. The Egyptians taught the rudiments of aſtronomy to the Greeks, and they probably received from that people the figure of a man in his place, whom not knowing what to make of, they called Perſeus, becauſe of the neigbourhood of thoſe conſtellations which they had before called Cepheus, Caſſiopeia, and Andromeda; they put the ſword into one hand, and the gorgon's head, by way of ſhield, into the other, and called him the deliverer of the lady.

Perſeus, they tell us, was the ſon of Jupiter by Danae. The father of that lady had been told, that he ſhould be killed by his grand-child, and having only Danae to take care of, he locked her up; but Jupiter found his way to her in a ſhower of gold, and Perſeus verified the oracle. The child was thrown into the ſea, but taken up by fiſhermen. When he was full grown, the gods, they tell us, all furniſhed him for exploits; Mercury gave him a ſword of adamant, that nothing could reſiſt, and wings for his feet; but the Greeks have omitted thoſe in the figure of the conſtellation. They needed not have done this, for there are, at leaſt, as many ſtars that might have got into them as into the ſword. Pluto gave him the helmet they have figured, and Pallas a ſhield; the helmet, when he pleaſed, rendered him inviſible; he cut off the head of the gorgon, and affixed it to his ſhield, and after many other great exploits, he reſcued Andromeda, the daughter of Caſſiopeia, whom the ſea nymphs, in revenge for that lady's boaſting of ſuperior beauty, had faſtened to a rock to be devoured by a monſter. Jupiter, his father, in honour of the exploit, they ſay, afterwards took up the hero, and the whole family with him, into the ſkies.

Among the enthuſiaſts, who have been for giving ſcripture names to all the conſtellations, Schiller, who always refers to the New Teſtament, makes Perſeus St. Paul; but Schickard, who has recourſe to the Old, calls

calls it David, and makes the gorgon's head that of Goliah.

PERSPECTIVE. The reprefenting upon a plane any object, in fuch a manner as it appears to the eye, when viewed in general, and at a diftance. The principles of this are often referred to in aftronomy, as affifting the imagination in conceiving the feveral reprefentations of the heavenly bodies. When this reprefentation is drawn perfectly according to rules, it no way differs from the appearance which the object itfelf makes. To effect this, the rays of light ought to come from the feveral parts of the picture to the eye, exactly as they do from the feveral parts of the object which the picture reprefents; and they ought alfo to come with the fame ftrength of light, fhadow, and colour.

When the eye is at a moderate diftance from the object, the projection of it is called fcenographic; when the eye is at a very great or infinite diftance from the object, the projection is called orthographic. Thus the projection of a globe is a circle, the projection of a circle, viewed directly, or perpendicularly, is a circle, but viewed obliquely, it is an ellipfis.

PESEBRE. A name by which fome have called the ftar in the conftellation Cancer, commonly called Præfepe, and by the Arabs, Malaph. Pefebre is the Chaldæan name.

PETER's BOAT, *or* ST. PETER's BOAT. Schiller, who will adapt fome part of the Chriftian hiftory to every conftellation in the heavens, has difplaced the Great Bear from its fituation near the north pole, and out of the ftars has made a reprefentation of a fifhing boat, which he calls Peter's Boat; others, of this enthufiaftic turn, have retained the figure as it is, but defired that we will underftand one of Elifha's Bears to be fignified by it, and the other by the Leffer Bear.

PETER's FISH. A name given by Schickard to the Pifcis Auftralis, or Fifh of the fouthern hemifphere, in whofe mouth is the bright ftar Fomahaut, and whofe jaws open to receive the water from Aquarius's urn. This is a very moderate innovation, fince it ftill leaves to the creature the form of a fifh. All that Schickard defires, being, that we may fuppofe it a reprefentation of that fifh taken up by the apoftle with the tribute-penny in his mouth; but Schiller makes much greater innovation, he puts a kind of tub here, and calls it the barrel of meal of the widow.

PHÆNICOPTERUS. A name by which fome, who are fond of new names, call the conftellation Grus, the Crane, one of the new-formed afterifms of the fourthern hemifphere. The word Phænicopterus is the Latin name of a tall bird, the Flamingo, and as this has a long neck, and long legs, the ftars which form the Crane may, without much diftortion, be thrown into the out-lines of its figure; but as the Crane is a much more known bird, there is no pretence for the multiplying names by the innovation.

PHÆNOS. A name by which Plato, and many other of the Greek writers, have called the planet Saturn, the moft remote of the whole number. The exprefs fenfe of the word is apparent, and they have been rallied who made ufe of it, as the name of Saturn, the leaft bright, and therefore the leaft confpicuous of all the planets; but the antients had reafon for what they did, though thefe, who are merry upon them, have not always apprehenfion to difcover what it was. Although Saturn

Saturn is the leaſt bright of all the planets, Saturn is the leaſt hid under the ſun-beams of all of them, and therefore he has a title to a denomination, which expreſſes his being more apparent; that is, not more bright or glaring, but more conſtantly apparent than all of them, as there is leſs time that he is obſcured by the light of the ſun.

PHAETHON. A name given by ſome of the old aſtronomical writers to Jupiter. It is ſuppoſed to have been given him on account of his peculiar ſplendor or brightneſs; but if this be the caſe, they ſhould certainly have given it to Venus, as that planet appears much more lucid than Jupiter. Jupiter is doubtleſs the ſecond of the planets in this reſpect; but it is ſingular, they ſhould give him a name more proper for the firſt.

PHALÆNA, *the Moth.* A name which we find, in ſome very old writers, uſed as the denomination of one of the conſtellations of the northern hemiſphere. The aſtronomers, who are fond of their improvements in the ſcience, have held in contempt the appellation Phalæna and Moth, as belonging to any figure in the heavens; but although it is among a ſet of men, not greatly to be reſpected for their ſcience, that we find it, yet we have reaſon to pay reſpect to the term, which perhaps, without underſtanding it, they preſerve, among many others, to themſelves equally unintelligible, from very early antiquity.

It is among the profeſſors of judicial aſtrology that we meet with the term, and however much we may contemn the doctrines of their art, yet we find ſome traces of the earlieſt obſervations recorded and preſerved among them, which are either totally loſt, or but very little regarded by any other writers.

We are to obſerve, that the Chaldæans, who were among the earlieſt aſtronomers, and from whom the knowledge of the conſtellations travelled into all other countries, blended together aſtronomy and judicial aſtrology. The country, in which they lived, being open, and the air clear, they had all the opportunities imaginable for making obſervations, and they did this with as much intent of judging by the influence of the ſtars, as any other. We find them poſſeſſed of a notion of the ſimilitude of certain of the fixed ſtars with certain of the planets, as it is at this time, though diſregarded by aſtronomers, preſerved among the aſtrologers; and there is, (however little there may be in the application) yet ſome degree of reaſon in the origin of the opinion.

The Chaldæans were the firſt who obſerved that the light of the ſeveral planets was very different, that of Jupiter being a pure and untinged white, and his alone ſo; the light of Saturn they perceived to be a bluiſh; that of Mars, as every one elſe has obſerved, ruddy; and that of Venus, yellowiſh; Mercury they determined to be alſo bluiſh; the tinct in all very ſlight, but in that planet ſlighteſt of all. Something of this may be perceived with us, but very faint; more of the difference is ſeen in Italy, where the air is clear; and it muſt have been moſt perceptible of all amongſt the Chaldæans, whoſe air is the moſt clear of all. They did not ſtop their obſervations here, they found, that, among the fixed ſtars, all were not of the ſame colour, but ſome of theſe alſo yellowiſh, ſome reddiſh, and ſome bluiſh. This alſo is an abſolute truth, and is owing to the difference of their materials, and of their purity. Thoſe, which were of an untinctured brightneſs, they ſaid, were of the ſame nature with Jupiter; thoſe, of a yellowiſh hue, they claſſed with Venus; thoſe, which were ruddy, with Mars; and thoſe, which were

ſimple

ſimply bluiſh, (for they made this diſtinction between the two other planets) they referred to Mercury; and thoſe of a glaucous, or greeniſh, blue, to Saturn.

This was the effect of great and accurate obſervation; their doctrine of the influences is idle, but the actual difference in tinct in the colours of the fixed ſtars, as well as planets, is no chimera. It is an obſervation worthy the aſtronomer, it was firſt made in Chaldæa, and it is preſerved among the aſtrologers of the ſucceeding ages.

I have taken this opportunity to obierve, that parts of the antient aſtronomy, that is, parts of the aſtronomy of thoſe nations who taught the rudiments of the ſcience to the Greeks, from whom the reſt of the world received it, is preſerved among theſe men, although not regarded by thoſe who profeſs the ſcience.

The conſtellations, we full well know, were of Egyptian origin; the Greeks obtained their knowledge of them from that people, and this not all at once, but by degrees, for their ſphere was not finiſhed when it was begun, but received continual additions. We ſee that the aſtrologers, in this inſtance already quoted, and it is a conſiderable one, have preſerved, from their predeceſſors the ſoothſayers of Chaldæa, a doctrine which the aſtronomers neglected. It will not be difficult to ſhew, that they have alſo preſerved this conſtellation from the ſame ſource, although it has been loſt in name, at leaſt by others. They obſerved thoſe things the moſt which were moſt immediately uſed in prognoſtics; and this conſtellation, if we find the means to aſcertain what it was, will be found to have all the claim that could be, on that ſcore, to their attention; and to have been uſed to that end by all nations of the world.

We perceive the Greeks giving peculiar names to certain cluſters of ſtars which made a part of other conſtellations; and I know no reaſon why we ſhould ſuppoſe the Greeks the firſt who did this. They learned from the Egyptians and Chaldæans, the reſt of their cuſtoms, with reſpect to arranging the ſtars, and they followed them faithfully. There is no reaſon why we ſhould doubt but they have done the ſame in this.

One of the principal cluſters of ſtars which they have thus honoured with a peculiar name, is that called the Pleiades, and why they ſhould be ſuppoſed to have done this, otherwiſe than in conſequence of the Egyptians or Chaldæans having done it before them, I know not. They received the Bull, in which this leſſer conſtellation is placed, accordingly from the Egyptians, and why not the conſtruction in the conſtellation, or the peculiar degradation of this cluſter of ſtars within it. The Pleiades were underſtood by the Greeks as ſtars of a friendly nature, and we find them ſo underſtood by thoſe who have followed them. Our own poet ſpeaks of

The grey dawn and the Pleiades
Shedding ſweet influence;

and we have all the reaſon in the world to ſuppoſe that the Chaldæans gave this with the reſt to the Greeks; if ſo, they muſt have taken notice of the cluſter of ſtars, and they muſt have had ſome peculiar word by which to expreſs them. The Greeks, when they had received, might not underſtand that word; they might call the cluſter of ſtars Pleiades, not alluding to any particular figure; but the Egyptians, making it a cuſtom to ſpeak of arrangements of the ſtars only under the names of thoſe animals, under whoſe figures they had diſpoſed them, moſt probably had, out of reſpect to this little cluſter, which they ſuppoſed

to

to have great influence, given it, though in the compaſs of a large conſtellation, a peculiar form in itſelf, and called it by the name of that animal under whoſe out-line they had compriſed it.

They muſt have uſed ſome very ſmall animal to this purpoſe, and the Moth ſeems very well to ſuit the purpoſe in this ſenſe, it bearing ſomewhat like the ſame proportion to a bull, ſpeaking in a general manner, that this cluſter does to the whole conſtellation. It was natural for the Chaldæans to repreſent theſe ſtars, called by the Greeks the Pleiades, under the figure of ſome animal; that animal muſt be a little one; and the followers of the Chaldæans mention a conſtellation unknown to the ordinary aſtronomers, under the name of Phalæna, the Moth, and they mention it as a conſtellation of peculiar influence. They ſay, that as ſome ſingle ſtars were of the nature of Jupiter, and they ſay the ſame of theſe all together, which formed this conſtellation, that is, they called them friendly and benevolent ſtars, and promiſed mankind ſomething favourable at their riſing; this agrees very happily with the influence that is allowed by almoſt all writers to the Pleiades, and this is one of the many things that might ſerve as a collateral proof that this Moth, and the Pleiades, are the ſame arrangement of ſtars.

There is alſo a farther proof of the ſame origin. We are to obſerve, that the antients ſometimes contradict themſelves with reſpect to the influences of the ſtars, nor is it a wonder, that there ſhould be all this uncertainty in a thing which has in itſelf no foundation in fact. While they applaud the Pleiades for their benign influence, they alſo make them the cauſe of tempeſts; and, in the ſame manner, the modern aſtrological writers, from the ſame ſource, whence the oldeſt authors had their informations alſo of this kind, tell us, that the Phalæna was a tempetuous ſign, and adviſe the mariner to beware how he leaves port juſt at the time of their ſtrongeſt influence. When authors agree even in thoſe points that ſeem in themſelves diſcordant, they by that give a ſtrength to one another; or when that is not the caſe, they know, by the ſtrongeſt proof imaginable, that they have their informations from the ſame ſource. We ſee by a thouſand inſtances, that the aſtrologers of late times have taken their opinions from the aſtrologers and ſoothſayers of old; and as to the antients, whoſe works we have at this time preſerved to us, we know them to have all imbibed their opinions from the ſame ſource. The Greeks obtained their firſt rudiments of aſtronomy from the Egyptians, and the Romans from the Greeks; and we are not to wonder, if while the race of aſtrologers, who follow the informations received from the old Chaldæans, and tranſmitted down through ages to them, call the Phalæna a conſtellation, which preſages, or which, as they expreſs it, occaſions ſtorms; Horace, when he has a mind to deſcribe the fury and the impetuoſity of a warrior by a tempeſt, talks of the ſame conſtellation, and tell us, that he brought confuſion amongſt them:

Indomitas prope qualis undas
Exercet auſter Pleiadum choro
Sciendente nubes.

We have all the reaſons to ſuppoſe, that the Chaldæans of old had a name for the Pleiades as a conſtellation, and yet no name of theirs is preſerved to us, at leaſt none by which we underſtand any peculiar form, or object of arrangement. We find, that the ſucceſſors, ſuch as they are, of the Chaldæans and ſoothſayers, do diſtinguiſh a conſtellation, though they know not perhaps what it is, under the name

name of a Moth. Phalæna, to which they attribute influences good and bad, in all reſpects the ſame with thoſe which the claſſics attribute to the Pleiades. We find in the ſcriptures alſo the name of a conſtellation which has been tranſlated Pleiades, and which, whatſoever were its real name, is univerſally received to be the ſame with the Pleiades. Now if we have recourſe to the original Hebrew, we ſhall find the name there to be *Aiſh*, and we ſhall find, that, in the ſame language, the word *Aſh*, which is very near it in ſound, ſignifies a Moth, a fly that wanders about by night, as a worm that eats garments. The moth that eats garments is only the reptile ſtate of one of theſe night flying moths, or butterflies, as the caterpillar is to the ordinary butterfly, and the Hebrews might therefore very properly call both by the ſame name. There is all the appearance in the world that this was the original deſignation of the conſtellation, and that the Greeks, who took notice of it, afterwards loſt or forgot the word; and as they found it neceſſary to denote by ſome name, or other, a cluſter of ſtars which they uſed in their obſervations, they gave to them a name of their own, Pleiades, or Pleiones, ſignifying no more than that they were ſeveral ſtars together. It is certain by all obſervation, that the Pleiades was a cluſter of ſtars taken notice of by the very earlieſt writers. The very oldeſt, whoſe works are extant, if they name but three or four of the conſtellations, always have this of the Pleiades for one. Homer and Heſiod, who are the oldeſt we know, mention the Pleiades, and three or four others, and it is ſingular, that thoſe which they do mention, are the ſame with thoſe which we have alſo in the ſcriptures, Orion and the Pleiades making the ſame figure in both. That the word which the Septuagint has rendered Pleiades, was intended to convey the mention of the ſame ſtars which the Greek poets meant by that name, is not a doubt, and this was the Moth of our aſtrologers. It is not a wonder they ſhould agree about theſe things. The earlieſt knowledge of aſtronomy was in the eaſt, and thence the Greeks learned it. We are aſſured of obſervations of the Egyptians between ſeven and eight hundred years before the birth of Chriſt, and the nations that were in their neighbourhood, or had any concern with them, might be ſuppoſed, very naturally, to become acquainted with their opinions. The Greeks received their knowledge from the Egyptians, and it is therefore not at all wonderful, if the Jews and the Greeks ſpoke of the ſame conſtellations in their writings.

PHANES. A name by which ſome of the old aſtronomical writers have called the Sun.

PHARETRA, *the Quiver*. One of the Arabian conſtellations. Theſe people were forbidden by their religion to draw any human figures; ſo they diſplaced the archer, and retained only his caſe of weapons.

PHARAS. A name by which ſome, who are fond of uncommon words, call the conſtellation Equuleus, or the Leſſer Horſe. It is formed of one of its Arabic names, which is Al Pharas, Al Acuval, and expreſſes the foremoſt horſe, the head of this being forwarder than that of the other over which it is placed. We may ſee by this how ill theſe introducers of antiquated words were qualified for doing it; they underſtood nothing of the meaning of the Arabic, but ſiezed upon the firſt word out of three or four, which together made a proper and expreſſive name for the conſtellation.

PHAROS. A name by which some, who are fond of uncommon words, have called the constellation Ara, the Altar. It is one of the old Greek names of that sign.

PHASES *of the Heavenly Bodies.* Astronomers express by the term Phase, that part of the heavenly bodies which is turned toward the earth, and is the object of our observation; and when they speak of the different Phases of the same luminary, they mean those several parts of its globe, or surface, which it exhibits at different times to the earth.

These phases of the sun, moon, and planets, have been the great means of discovering their revolutions, and of establishing their several theories. The diversity of phases which the same luminary shews to us at different times of observation, are owing to its revolution round its own axis. When a bowl is thrown along a green, we see, that beside its course forward, or in the direction in which it is delivered from the hand, it all the time turns round upon its own axis as it goes along, making a great number of these revolutions in the course of one cast. This is a motion found in all those of the heavenly bodies, which we have power to examine, and therefore probably is given to them all; and to this motion, as perceived by the assistance of telescopes, are owing nearly all the modern improvements in astronomy.

The sun revolves about his own axis, fixed as he is in all other respects. Although the firm centre of the universe, he is not excused from this common motion; and in consequence of this, he offers to us every day a different phase; and changes it, in some measure, even while we look upon him. Those spots, which have been discovered on his surface, change place continually, the old ones go off on one side, and new ones appear on the other; nor is this all, those which we trace along his surface appear smaller, or narrower on their entrance, largest when they are in the centre of his disk, and again smaller, as they approach the side where they go off.

This diversity of phases of the sun, in the first place, convinces us of the revolution of that luminary round his axis, and, by the return of the same spot to the same place, we determine the period of that revolution; while this change of figure, in the same spot, as seen on different parts of the disk, convinces us, that these spots are not, as some have supposed, planets revolving round the sun at small distances; or, as others have thought, exhalations raised from the burning matter; but parts adherent to his surface, probably solid, and hard matters rising above a lake of liquid fire.

That the fixed stars, in general, shew us the same phase, is what some have asserted; but as we cannot contradict it, because their great distance takes away the opportunity of observation, spots being not visible so far, so they who assert it, want the proof of their assertion in the same degree. It is indeed probable, that all the fixed stars do offer, at different times, different phases to us, although we cannot see them; since those called *new stars* are certainly and undoubtedly of the number of the fixed stars, and have their place in the heavens among them, and quite out of the system of our universe; and these do shew us different phases. We see them by degrees growing to their full lustre from very faint beginnings, at least, it is so of those which have been latest observed, and probably would have been of the others, if traced with the same accuracy; and all of them, even the famous one in Cassiopeia, declining afterwards from that full lustre, by degrees, to the size and appearance

pearance

pearance of the ſmalleſt ſtars, before they become quite extinguiſhed. This can only be ſolved by the doctrine of their having different phaſes, with regard to the earth at different times. We are to ſuppoſe a part of the globe lucid, and a part dark, perhaps a ſmall part of the one kind, and a larger of the other. The ſtar having a revolution in a long period, is quite loſt to us during the time of its dark phaſe, being preſented to us toward the earth, and grows larger and larger, as the revolution, by degrees, brings more and more of the luminous part in ſight; till we have the full enlightned phaſe: from which time the ſame revolution carrying it on, leſs and leſs of its luminous part is ſeen, that is, the ſtar becomes to our ſight leſs and leſs, till it is quite loſt. The returns of ſome of thoſe, called new ſtars, at tolerably regular periods, ſpeak loudly for this, and it is probably ſo with regard to all the others, although their periods may be different. On this plan the fixed ſtars do ſhew different phaſes as the ſun does, and thoſe phaſes prove their revolutions about their own axis.

The phaſes of the planets are different in the greateſt degree, and indeed are hardly the ſame at any time for half an hour together. In Saturn, becauſe he is ſo very remote, we cannot diſcover them indeed for the ſame reaſon that we cannot in the fixed ſtars, becauſe our teleſcopes have not ſufficient power, at leaſt I muſt confeſs this to be the caſe with regard to all that I am poſſeſſed of or have ſeen, but in all the others we ſee a continual change of phaſes, and, from that diverſity, are inſtructed in their theory. Mercury and Venus ſhew us the ſeveral appearances of the moon from the fine thin creſcent to the enlightened hemeſphere; and beſide this Venus has ſpots that mark the period of her revolutions round her axis. Mars, beſide his ſpots, which ſerve to the ſame purpoſe, has alſo his changes of form, though not ſo great as theſe two; and the ſpots of Jupiter return, like thoſe of the ſun, to the ſame part of his diſk, after a regular time which marks his revolution. We are alſo to mention, under the different phaſes of theſe planets, the ſingle and uncertain belt of Mars, and the ſeveral belts which appear at different times in various numbers on Jupiter. Saturn has been alſo ſuppoſed to have them, but what have been taken for belts in that planet, are at a diſtance from his ſurface, and are probably therefore clouds of a peculiar kind.

Even the ſatellites of Jupiter, and of the diſtant Saturn, have theſe changes in their phaſes. We cannot indeed diſtinguiſh the particular ſpots upon objects at once ſo remote and ſo comparatively ſmall; but we can determine that they have ſpots, and that thoſe are in different quantity on their ſeveral hemiſpheres. All the effect ſpots could have on ſuch little planets, with regard to us, would be, as they are more in number, to diminiſh the apparent bigneſs of the object, or, when ſufficient to that purpoſe, quite to hide it from us. This is exactly the caſe; the ſeveral ſatellites of Saturn, as well as Jupiter, appear to us at different times even when in the ſame parts of their orbit of very different ſizes, and the fifth of Saturn is often loſt to us, or quite diſappears, for a conſiderable time, without any apparent cauſe. This can be only owing to theſe little bodies turning to us ſometimes a lighter, and ſometimes a duſkier phaſe, and by this we are convinced at once both of their ſhewing us, at different times, different phaſes, and of the cauſe of it; which is a revolution of theſe little planets alſo (like the great ones, about which they move, and like the ſun about which thoſe

 great

great ones turn) round their own axis. There is also a farther observation to prove this revolution, and these different phases of the satellites of Jupiter; it frequently happens, that, in their course round that planet, they pass between the earth and its body. In this case, they ought to be seen travelling over it, according to the motion of their general revolution, but this does not always happen, the satellites and the planets both receiving their light from the sun, they have it in a degree nearly equal, and consequently the satellite is in a great degree lost to view when travelling before the planet. This is usually the case, and the best glasses, and the most accustomed eyes, can see nothing of it; but at other times we are able to trace the satellite, in a part of its course, in form of a little spot somewhat more dusky than the rest of the disk of the planet, and which would appear one of its natural spots, adherent to the surface, but for the different degree of motion. This can be owing only to the different phases of the satellite, which, when it has, in its revolution on its axis, turned a bright hemisphere toward us, is so like the planet itself, that it cannot be distinguished, but, when it turns a spotted surface, is so much more obscure than the body of the planet, that it can be distinguished on it.

Last of all, we are to examine the satellite of our own earth, the moon. This differs from all the other luminaries of heaven, so far as we know them, in that it always shews the same phase with respect to spots: what are called its different phases, being only different as it is more or less enlightned, or, in properer terms, as more or less of its enlightned hemisphere is turned to us. This is a very singular phœnomenon; it is most certain that the spots, which we see on the moon, are not at all times the same, and in the same position, the only variation is, that these spots, while they preserve the same position with regard to one another, do appear at times to approach a little nearer to, and to depart a little farther from, the edge of its apparent disk.

This singular appearance has occasioned some to suppose, that the moon made no revolution about her own axis, and certainly there was appearance in favour of such an opinion. These little variations were understood to be the effect only of certain ballancings of the moon's globe, motions such as we see in a bowl when we change the centre of gravity: these they called librations of the moon. It is certain that the moon always does present the same phase to the earth, only that different parts of it are, at different times, enlightned, and this is singular to the moon, so far as we know, among all the heavenly bodies. The moon, however, although she does always present the same phase to us, has a revolution round her own axis, as has been already explained at large under the proper article. *See* MOON.

PHATRA. A name by which the Greek astronomers have called a large star in the constellation Cancer, the same that the Arabs call Malaph, and others Præsepe.

PHECCA, *or* AL PHECCA. A name by which some, who are fond of obscure words, have called the constellation Corona Borealis, the Northern Crown; it is one of the Arabic names of that constellation, and signifies Apertio, or the opening of something. They call it also Al Iclil.

PHED. A name by which some, who are fond of uncommon words, have called the beast that is in the hand of the Centaur; we generally call it a wolf, and the common name of

of the whole constellation is Centaurus et Lupus, or, Centaurus cum Lupo; but this is not authorized from antiquity, for the antients called it only Fera, a wild beast in general. This word Phed is one of its Arabic names, and it signifies a panther; so that we see the antients, when they gave it the name of some peculiar beast, were not at all agreed about what beast that should be. The Greeks, in general, call it Therion Fera.

PHER. A name by which some, who are fond of using uncommon words, have called the Centaur; it is one of the old Greek names of that constellation.

PHILIP, *or* St. Philip. A name given by a set of enthusiastic writers, with Schiller at their head, to the constellation Libra; he has taken away the Balance, and placed the figure of this saint in the place. Schickard is more moderate, he retains the figure, and only desires men to believe that it means the Tekel, the balance in which the tyrant was weighed and found wanting. It has been the fate of this sign to meet great changes, and suffer the most revolutions of any of the zodiac. If we credit the earliest accounts, and the earliest monuments of the Egyptians, a balance, or something like a balance, was the original figure. The Greeks displaced this, and extended the claws of the Scorpion, who occupies the next division of the zodiac, into this, making that creature occupy two signs; but the Romans, after all this, not willing that the twelve divisions of this important circle should have but eleven figures, cut off these claws, and placed their emperor Julius Cæsar there, as he is represented, on some antient gems, holding a balance in his hand. After-ages dropped the emperor, and retained the scales, and Schiller put out them, and set the good apostle in their place. We are not at all to wonder that kingdoms on the earth are unquiet, when we see men are able to make these revolutions even in the heavens, but nothing is so idle. We receive the Greek stories that are connected to the figures in the skies as fable and folly. Nobody, after he left school, ever regarded them; and to alter the figures is to create endless confusion in the science, and to give up all the advantage of early observations.

PHOCA, *the Sea-Calf.* A name of one of the Arabian constellations, it stands in the place of our Andromeda; they were forbidden by their religion to draw any human figures, and they placed this monster in the place of the lady; they have served Cassiopeia and the rest as badly.

PHŒNIX. One of the constellations of the southern hemisphere, it is one of the new-formed signs, and therefore is not to be expected among the old ones mentioned by early authors; it is not a constellation of any great extent, nor does it comprise a number of stars greater than is proportioned to that space which it occupies in the heavens.

The constellations, between and among which the Phœnix is placed, are the Crane, the Toucan, the head of the Hydrus, and the bottom of the Eridanus. The Crane is very near to the Phœnix, the right wing of that reaches nearly to the left of this constellation. The back of the Toucan is just by its feet, as is also the head of the Hydrus that is more under them than the back of the Toucan, which comes down rather on one side, and on the other is the very termination of the river Eridanus, the great and bright star which marks that termination being placed just under the right foot of the Phœnix.

This

This bird is represented as standing on a kind of pedestal, with its feet at some distance from one another, its head is turned to the right side, and its wings extended, and, in countenance of the old fable of the burning of the Phœnix, there is a cloud of smoak behind it. The stars accounted to belong to the Phœnix are thirteen, some of them are considerable enough to make the constellation conspicuous, and the rest are disposed in such a manner as very well to mark out the form. There is a large and bright one at the bottom of the neck, and a smaller near it; there are two considerable ones at a distance below these on the body, and two near the feet, one a smaller between them, and the other a larger on the pedestal near the left foot; the right wing has three, and the left four, but of the last two are almost out of the verge of the figure; the cloud of smoak is decoration; there are no considerable stars in it.

PHOLOS. A name by which some of the old astronomers have called the constellation generally known by the name of the Centaur. They say this Pholos was a centaur, and was particularly skilled in divination, and they suppose him placed with a victim in his hand over the altar, as if ready to sacrifice it, and to inspect the entrails. *For an account of the constellation, see* CENTAURUS.

PHORBAS. A name of one of the northern constellations, more generally called Ophiucus and Serpentarius. The Greeks tell us, among other stories, that this Phorbas was an hero, a son of Triopas, and that, after many exploits, Apollo, for his killing a monstrous serpent, took him up to heaven. Others say that it represents Hercules in Lydia, or Carnabos. *See the article* OPHIUCUS.

PHOSPHORUS. A name by which many of the old writers have called the planet Venus, but they used this name only when they spoke of her as appearing before the sun-rise in a morning, at which times they looked upon her as the harbinger of day; when she was an evening star, they called her Hesperus.

PIÇLÆUS. A name by which we find the planet Jupiter called by some of those writers who love uncommon terms. This is, originally, an Egyptian word, and it was used by that people as a name of that planet. The meaning of the word is the father of life. The Greek Zeus, a name of this planet, and of the deity after whom it was named, is also of the same signification, and seems a translation of it.

PIGEON, *Columba*, and *Columba Noachi*, *Noah's Dove*. A name of one of the constellations of the southern hemisphere; it is not of the number of the old forty-eight mentioned by the early authors, but it is one of the new constellations formed there by late astronomers. *See* COLUMBA NOACHI.

PIKOTORION. A name by which some, who are fond of hard words, have called the constellation Pisces; it is the Coptic name, and signifies Piscis Heri.

PIMENTEKEON. A name by which some writers, fond of hard words, have called the constellation Leo; it is the Coptic name of this sign, and, in that language, signifies Cubitus Nili. There is some reason to suspect from this, that the figure of a lion was not always placed in this division of the zodiac.

PINACION. A name by which some have called the Corona Borealis; it is borrowed

rowed from the Greeks, and ſignifies Diſcus. They alſo call it Periacis.

PINNA, *or* PINNA MARINA. A conſtellation offered to the aſtronomical world, and formed of a cluſter of very conſpicuous ſtars near the left foot of Antinous. The occaſion of making new conſtellations is in no part of the heavens ſo conſpicuous as with reſpect to this of Antinous. The ſtars of which it is compoſed, although of a very conſiderable conſequence as to the ſize, and of conſiderable number, were formerly reckoned among thoſe of the Eagle, or rather were counted with them under the name of the unformed ſtars of the Eagle; although ſome of them are very remote from that conſtellation. It was a great aſſiſtance to the aſtronomers to arrange theſe into a new conſtellation, and yet this has not done what was intended perfectly, for ſtill there remain a cluſter of conſiderable ſtars between Antinous and Ophiucus's Serpent, ſo ſituated, that they are as near one as the other, and as proper to be added to the numbers of one as of the other. It is of theſe that the new conſtellation, here propoſed, is formed.

It is of ſmall extent, and it takes in but few ſtars, but they are large, conſpicuous, and, as has been already obſerved, remote from all the other conſtellations. The creature, under the out-lines of whoſe figure they are repreſented, is a ſhell-fiſh, an inhabitant of the ſeas, ſomewhat approaching to the nature of the muſcle kind, but very large, and having, in the place of their beard, a tuft of fine ſilky matter of great length, of which, in ſome places, they make gloves and other manufactures. Itis repreſented in the conſtellation with the ſmaller end, or head, upwards, the lip downward, and the tuſt, or beard, extended.

The conſtellations, between which it is placed, are Antinous, the Serpent, and Sagittary. There is a large extent of the heavens between theſe, but it is only in that part of it near Antinous that there are any conſpicuous ſtars, all about the head of Sagittary is in a manner vacant. Theſe ſtars, toward Antinous, are the cluſter which make the new conſtellation; the whole figure of the ſhell ſtands between the tail of the Serpent and the two feet of Antinous, and the beard is extended almoſt to one of thoſe feet; the head of Sagittary is directly under the ſhell, but it is at a great diſtance.

The conſpicuous ſtars in the Pinna are only ſeven, but they are very conſpicuous, and they are diſpoſed in the following manner. One of them is at the extremity or head of the ſhell; this is not a very inconſiderable ſtar, and yet it is ſmaller than any of the other ſix. There is another ſingle ſtar a little lower down, juſt where the beard has its paſſage out of the ſhell. In the beard itſelf there are two, one at the extremity, and the other at a little diſtance from it, and the other three are at the other end of the ſhell near the lip of it, one of them is at one corner of the lip, another is in the out-line a little above it, and the laſt is on the verge of the lip, but not at the corner.

PINOITEN TEPITOK. A name by which ſome, who will go the fartheſt part of the earth for an hard word, have called the Via Lactea, or Milky Way. It is a term that has been uſed to expreſs it, for it is the Coptic name of that part of the heavens; but there can be no reaſon why we ſhould have recourſe to theſe ſtrange terms to expreſs things for which we have names ſo univerſal and familiar. Having mentioned that this is the Coptic name of the Milky Way, it may not be improper to obſerve,

observe, that its signification is not the same with the Greek and European names of this part of the heavens. The words Pinoiten Tepitok do not signify a way of milk, but a way of straw, and this is the sense of those names by which the Via Lactea is called in all the eastern languages. The Greek story we know is, that the Milky Way was owing to Juno's spilling some milk from her nipple; but the Egyptians have their mythology as well as the Greeks, and, as the European nations in general have followed the Greek, the eastern in general have followed the Egyptian. The story of these people is, that their goddess Isis, being pursued by Typhon, threw down burning straw all the way behind her, and that this road in the heavens is a commemoration of this path. By this they meant Semiramis, whom they deified after her death; and the giant Typhon signifies no more than a land-flood, very sudden, and very terrible, in that part of the world.

PIORION. A name by which some have called the bright star in the Bull's eye, called also Aldebaran. This Piorion is the Egyptian name, and signifies the station of Horus.

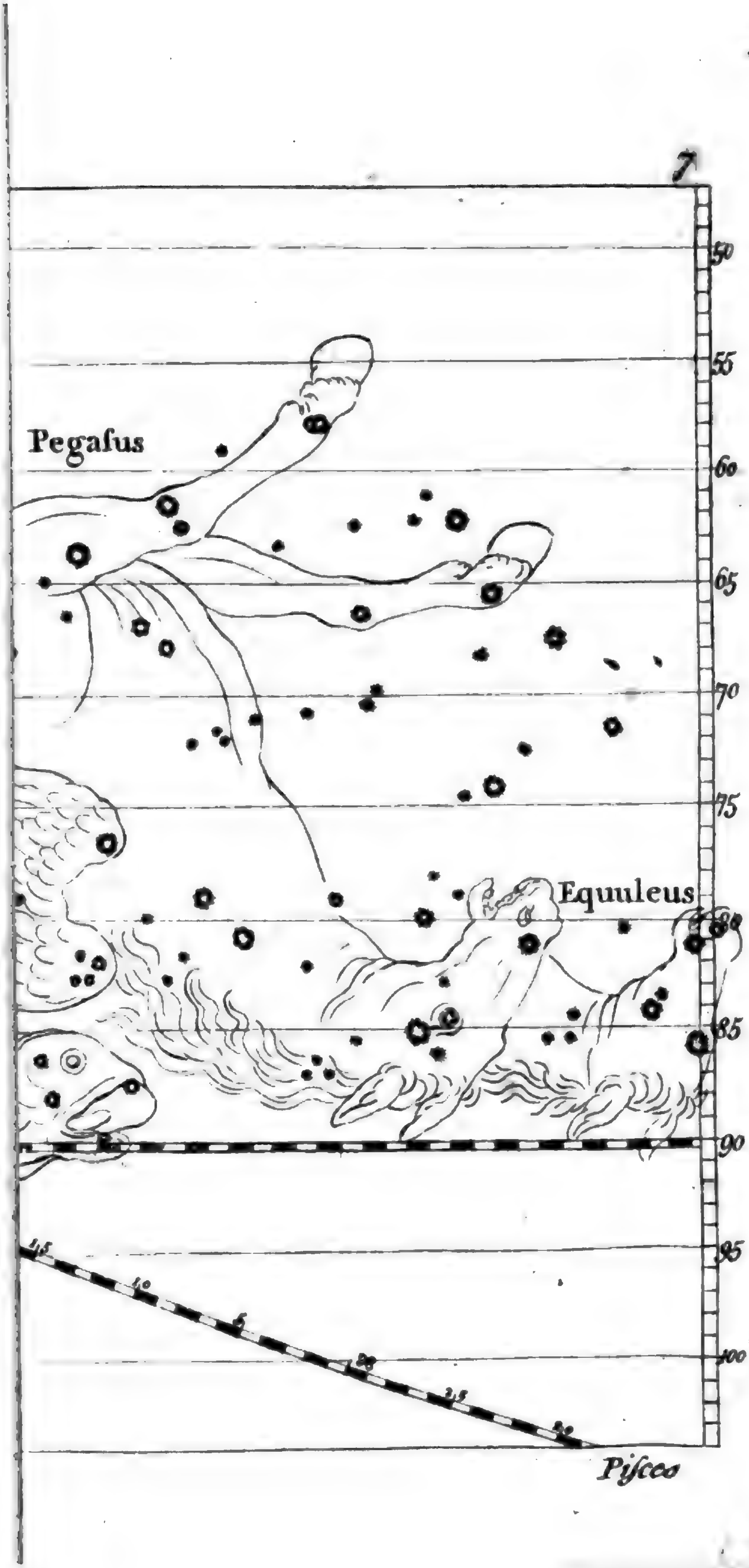
PISCES. One of the constellations of the northern hemisphere, and one of the twelve signs of the zodiac, of which it is called the twelfth, or last. This is one of the old forty-eight constellations which the Greeks, of very early time, received from the Egyptians, and which they have transmitted down to all other astronomers; it is preserved to this time in the heavens in the same place, and under the same form, in which it stood with them, and with their instructors.

Pisces, taking in the whole composition of the figure, is a considerably large constellation, and contains, even in proportion to that extent, a large quantity of stars, and those disposed so happily, that the whole composition is well marked, and easily distinguished in the heavens.

The constellation Pisces does not, as most of the others, consist of a single figure; it is composed of three parts, two fishes placed at a considerable distance from one another, and a long line or chord that connects them together. The fishes are not very large, but the line is of great length, and is folded and waved. The fish are not of any particular species, nor was it necessary, all that was intended to be represented was two fish, and no peculiar or specific name was ever given to them; they are represented as thick and short fish, with very large heads, open mouths, and forked tails; just above the tail of each fish there is figured a kind of ring, to which is fixed the end of the cord; the cord seems broad and flat, and is not carried strait from one of them to the other, but, for the sake of taking in the greater number of stars, is twisted about, and in one part has a knot toward the middle, which serves as the mark of one considerable star.

The constellations, to which the two fishes are near, are Aries, Andromeda, Pegasus, Aquarius, and the Whale. The upper fish is represented in a posture nearly perpendicular, and the lower in one nearly horizontal with respect to the ecliptic. The Ram is very near to the upper fish, his head is within a small distance of its tail, and the urn of Aquarius is very near the nose of the lower; the head, and part of the body of the upper fish, fall upon the breast of Andromeda, and the back and wing of Pegasus are very near the back of the lower fish.

The antients counted thirty-eight stars in the constellation Pisces, Ptolemy sets down so many, and, as he is an exact follower of Hipparchus,


7
50
55
Pegasus
60
65
70
75
Equuleus
80
85
90
95
100
Pisces

parchus, we may ſuppoſe, with good foundation, that was the original number. Tycho Brahe ſets down thirty-ſix ſtars in the ſame conſtellation; and Hevelius, as he had taken two from the original number, added one to it, he makes them thirty-nine. It is an amazing addition that is made by Flamſtead, he deſcribes on hundred and thirteen ſtars in this conſtellation.

Of theſe it is very ſingular that there is not one of the firſt or ſecond magnitude; nay, there is only one generally allowed to be of the third; there is another, but its title to this rank is diſputed, and moſt authors degrade it into a fourth. Both theſe are in the lines, the allowed third is at the knot of the line, and the other is the northermoſt of three in the north line. The reſt are in general of the ſmalleſt kind, a vaſt number of them are of the ſixth magnitude, but they are diſpoſed with ſuch an equality and regularity on the ſeveral parts of the conſtellation, that the whole is eaſily traced by the eye in the heavens.

The Greeks, who have ſome fable to account for the origin of every conſtellation, tell us, that when Venus and Cupid were one time on the banks of the Euphrates, there appeared before them that terrible giant Typhon, who was ſo long a terror to all the gods. The deities immediately, they ſay, threw themſelves into the water, and there acquired the form of a couple of fiſhes, under which they eſcaped the danger. The Syrians, they tell us, from that time refuſed to eat fiſhes, and would never ſuffer any to be caught for fear of diſlodging a deity. Thus idle are the Greek fables in general, by which they have pretended to account for the origin of the conſtellations. The Egyptians, from whom the received them, were a people of another ſtamp; they uſed the figures, which they placed in the ſkies, as parts of their hieroglyphic language, and, by the twelve, which characteriſed the ſigns of the zodiac, they conveyed an idea of the proper employment during the twelve months of the year. The Ram and the Bull had, at that time, took to the encreaſe of their flock, the young of thoſe animals being then growing up; the maid Virgo, a reaper in the field, ſpoke the approach of harveſt; Sagittary declared Autumn the time for hunting, and the Piſces, or fiſhes tied together, in token of their being taken, reminded men that the approach of ſpring was the time for fiſhing. Thus ſimple are things in their origin, which affectation and pedantry have made ſo pompous, obſcure, and fooliſh.

The antients, as they gave one of the twelve months of the year to the patronage of each of the twelve ſuperior deities, ſo they alſo dedicated to, or put under the tutelage of each, one of the twelve ſigns of the zodiac. In this diſtinction the fiſhes naturally fell to the ſhare of Neptune; and to this whimſical dedication of the ſign to that deity, has been owing all that folly of the aſtrologers, which have thrown every thing that regards the fate of fleets and merchandiſe, under the more immediate patronage and protection of this conſtellation.

PISCIS AUSTRALIS. One of the conſtellations of the ſouthern hemiſphere. It is one of the old forty-eight, and is mentioned by all the writers on aſtronomy.

It is a conſtellation of very ſmall extent, and contains only a few ſtars, but they are ſo well diſpoſed, according to the lines of the figure, that it is eaſily diſtinguiſhed, and one of them, in particular, is ſo large, that no conſtellation in the ſouthern hemiſphere is more conſpicuous.

The Southern Fiſh is repreſented in the ſchemes of the heavens in form of a fiſh in general; but it would not be eaſy to refer it to

to any particular ſpecies, nor was that intended; it is drawn thick, and with a large tail, and with its mouth open to receive the water. The ſtream from Aquarius's urn, as already obſerved, terminating there.

The conſtellations, between and among which the Southern Fiſh is placed, are Aquarius, Capricorn, the Crane, and the Phœnix. Aquarius's left foot comes very near the tail, and his right is at a little diſtance above the head: the belly of Capricorn is alſo a little diſtance from the tail, as is alſo the head of the Crane, and one part of the ſmoke about the Phœnix comes toward the breaſt of the fiſh.

Ptolemy allows eighteen ſtars to this conſtellation; he took this account from Hipparchus, and many of the antients from him; Flamſtead makes them twenty-four; one of theſe is of the firſt magnitude, and is a great and glorious ſtar; it is that at the mouth of the fiſh, and is called, by a peculiar name, Fomahaut. There are ſeven or eight others conſpicuous enough in the body, and they are diſpoſed very well about its ſeveral out-lines, ſo as to mark its figure, and there are two conſiderable enough to ſtrike the eye in the tail. It would have been eaſy to have taken a figure that would have compriſed ſome ſtars, which are at preſent left unformed behind the tail of this fiſh; but the Egyptians, who, without a queſtion, were the deſigners of all the old conſtellations, had their reaſons for the peculiar animals they gave to the ſeveral parts of the heavens; of which one are, in a great meaſure, ignorant, and which the Greeks never gave themſelves any trouble to enquire after. The oldeſt writers ſeem to acknowledge this conſtellation of Egyptian origin, and even to point out a way to the underſtanding, why it was honoured with a place in the heavens, under the peculiar circumſtances in which we ſee it. It is repreſented as drinking up the water of a whole river; and the old writers ſay, that it was recorded, at one time, to have ſaved, or preſerved Iſis when in danger. The old people deified great ſovereigns and great conquerors. One of the firſt founded monarchies in that part of the world where this conſtellation was formed, was the Babylonian. Semiramis, or Hamamah, for that was the true name of the queen, was the founder of this, and there is no wonder ſhe is deified. We are told, that Venus, when ſhe was once in danger from the giant Typhon, threw herſelf, and her ſon Cupid, into the Euphrates. There are a thouſand reaſons to believe, that Venus was no other than this Semiramis. We are told of her having two ſons, and one of them is recorded to have been loſt. This Semiramis had two ſons, ſhe was fond of one more than the other, and this favourite ſon was loſt. The Adonis of the Greeks was doubtleſs this ſon, and her love was no more than a motherly affection, and that he was not killed by a boar on the mountains, but drowned in ſome river, is to be collected from the very circumſtances of the ſolemnities eſtabliſhed in memory of his death. The lamenting for Thammuz is known to be commemorating the death of Adonis, and, in this ſolemnity, they threw an image of the youth into the river.

We are forced to go very far round for the explanation of one of theſe ſtories, for they depend upon one another. This giant Typhon, which is frequently talked of as coming ſuddenly upon the gods when they were in Egypt, is no more than a land flood; this appears from inconteſtible proofs, too long and tedious to be produced here. We find then, that Venus, in Egypt, throwing herſelf, and her ſon, into the river, on ſight of Typhon, who threatned her with deſtruction,

is very probably Semiramis, betaking herſelf with her favourite ſon to a boat or boats, in the time of a land-flood in which ſhe eſcaped, but the youth was drowned. The Greeks borrowed their fables often from the Egyptians, and not being maſters of what they were about, often blundered upon words. Some name of a river, ſignifying alſo a boar, probably occaſioned the ſtory of his being killed by a boar; but we find, though the hiſtory failed, the rites and ceremonies ſtill preſerved the memory of the truth.

We ſhall ſoon come to explain the figure of the fiſh, to get at which all theſe windings are neceſſary. We find this very ſtory of Typhon, and of the goddeſs, and her ſon, throwing herſelf into the river, preſerved in the conſtellation Piſces. All the fabuliſts ſay, they were placed in the zodiac, to commemorate the forms into which that goddeſs, and her ſon, transformed themſelves on the occaſion. Now if the fiſhes preſerved the memory of Venus and Adonis, for he was one of the two Cupids, or, in plain words, of Semiramis, and her beloved ſon, throwing themſelves into the river to avoid the danger of a land-flood, which they always repreſented as a giant, threatning the lives of the gods; it is extremely probable, that Aquarius was this Typhon, or a land-flood, repreſented under the form of a man, pouring a ſtream of water out of an urn, with a ſudden violence. If this be allowed, what then is the Southern Fiſh ſwallowing up this water? And as the fabuliſts themſelves ſay, ſaving the deity, or deified empreſs? Let us look into the cuſtom of hieroglyphics in this nation, and we ſhall not be at a loſs. We know, that it was cuſtomary with the Egyptians to repreſent the earth by an ox, and the ſea by a fiſh, their inhabitants. They ſay, a fiſh ſwallowed up the water of Typhon, and that Venus was ſaved, that is, Semiramis, in the danger of a ſudden land-flood, committed herſelf in a boat to the river, and the flood running quickly into the ſea, or being ſwallowed up by a fiſh, that is, by the ſea, ſhe eſcaped. There are many paſſages in hiſtory that countenance this relation: and it is not a wonder, that a people who adored the empreſs as a divinity, ſhould pay divine honours to the Fiſh, which they made a repreſentation of the ſea, and place it among the ſtars: that they did pay it theſe divine honours we have abundant teſtimony. We find the old writers recording, that the Syrians preſerved the figure of a fiſh gilded among their houſhold gods, and paid divine honours to it.

The enthuſiaſts, who were for reforming the ſphere, have laboured variouſly on account of this fiſh. They have called it, in general, the fiſh of St. Peter, or that in which the penny for the tribute was found; but Schiller, and his followers, are not ſo eaſily ſatisfied; they take the whole figure away, and put in the place of it a barrel, which they call the barrel of meal of the widow, in the ſcripture.

Piscis Magnus. A name which ſome have given to the conſtellation Piſcis, in the ſouthern hemiſphere. But it is not of a bigneſs to authoriſe this epithet; others call it Piſcis Solitarius, to diſtinguiſh it from the true fiſhes of the zodiac.

Piscis Sacer. A name by which ſome have called the Dolphin; it is an old name for this conſtellation; and the Greeks expreſſed it by a phraſe of the ſame meaning, Hierus Ichthys.

Piscis Volans, *the Flying Fiſh.* One of the conſtellations of the ſouthern hemiſphere.

It is not to be expected in the writings of the antients, for it is one of the new ones, added by the astronomers of late time to their forty-eight. It is a constellation of small extent, and comprises only a few stars; but these are so favourably disposed that the figure is very well marked, and easily distinguished in the heavens.

It is represented in the schemes in figure of what is called the Flying Fish, a sea fish of the smaller kind, which has extreme long fins, that serve it occasionally in the place of wings, and by the assistance of which it leaves the waters, and betakes itself to the air, to avoid the pursuit of larger fishes, flying, as long as the fins continue moist, and then of itself falling again into the sea. The figure is tolerably well drawn; the creature is represented with its long fins extended in a posture of flying, and is in a direction nearly parallel with that of the trunk of the Royal Oak, near which it is placed. The other constellations that are about the Flying Fish, are the Ship, the Sword Fish, and the Chamelion. The head, and the upper part of the body of the Flying Fish, are near to the lower part of the trunk of the Royal Oak, and its head is pointed up toward the branches, part of the bottom of the Ship comes on its opposite side, the tail of the Chamelion reaches very nearly to the fin, on the same side on which the trunk of the Oak is placed, and the tail is directed toward the head of the Sword Fish.

The stars which compose this constellation are only eight; but they are, as has been already observed, very happily disposed on the figure, one of them is on the head, and one at the tail, these mark the exact length, and there is one on the body, nearer to the tail than to the head, but toward the middle: there are some others on the fins, very well disposed, and one near the tail, which though an unformed star, and not in the lines of the figure, yet serves to mark the constellation.

PITCHER. A name of one of the northern constellations, according to Schiller, in his Christian scheme of the heavens. He has altered the Dolphin into this figure of a vessel, and calls it the Pitcher of the Canaanitish woman; Schickard leaves the figure as it was, and only calls it the Leviathan. The innovations of Schiller, if any regarded them, would make great confusion.

PLACE OF VIEW. A thing of great importance in astronomy, and its differences necessary to be understood, in order to the properly using the observations of authors who have written on the subject. For the phœnomena of the heavens are so very different, seen from different quarters of the earth, and the absolute place of them so variously described by authors, who use different principles with regard to the place and direction of the sight, that their words, being ever so distinct, may mislead without the caution of first settling this point. The earth is the general place of view, since it is from some one part, or other of it, that all who have written have seen the thing they have described; but the earth being of a globular, or spherical form, the same appearances will not be had from the same objects, seen from different parts of it, or from particular places of view; and the climate and condition of the air will also impede, or promote the nicer researches: and, additionally to all this, men, from different first principles, will speak differently of them, even when they are the same with respect to their place.

It becomes necessary therefore to consider what was the place of view, and what the manner

manner of viewing, before we determine on any of the nicer obſervations. Thus, if we read of the riſing and courſe of the revolution of any of the heavenly bodies, with references to their ſeveral places in the heavens, we are, before we determine any thing upon them, to conſider in what part of the world he, who made the obſervation, was at that time; ſince we very well know, that from the figure of the earth, and its motions, the ſame luminary muſt riſe in the north, in a manner very different from that in which it riſes in the eaſt, and in both very differently from the manner in which it is ſeen to riſe in ſome of the intermediate countries. Thus, till it is underſtood that there is ſuch a difference, all the obſervations made in remote parts will be full of confuſion; and when that is known, very little uſe can be made of them in the theory of the ſcience, till it is known exactly what that difference is. The figure of the earth being however certain and known, and it motions regular, and alſo known, the diſcovery of this, with the ſufficient exactneſs, is not difficult.

With reſpect to obſervations that have been made, with great preciſion, and by men who were great judges of what they were doing, the ſame caution is required of knowing when they were made, before we preſume to fix any determination concerning them. Theſe often refer to things which we are to ſeek in the works of thoſe who deliver them, or look after in vain. Now, although we do not find what they ſay they ſaw, we are not to cenſure them as dealing unfairly with us in the account, or endeavouring to ſupport a ſyſtem by a pretence of ſeeing what was not ſeen, till we have fairly conſidered this circumſtance. It is not only that different parts of the globe, in reſpect to their ſituation, favour different obſervations; but the very difference of the air, in purity, will render things viſible in ſome, which are beyond all ſight, or are, at the beſt, very faintly and obſcurely ſeen in others. Thus, to give an inſtance in a matter that concerns the unaſſiſted ſight. We can ſee, that Mars is of a ruddy colour, and Jupiter of a ſilvery brightneſs; and we can perceive, that the fixed ſtars are diſtinguiſhed by their twinkling, from the planets which yield a ſteady light; and this is all that we readily diſtinguiſh by caſting the eye up to the heavens in England. Now when we read the works of the Arabs, and of certain other writers, who have, ſome way or other, borrowed their knowledge from the Chaldæans, or from thoſe who derived it from them, we meet with a great deal more reſpecting obſervations made with the unaſſiſted ſight. We find thoſe who wrote before any of the preſent aſſiſtances to it were diſcovered, ſpeaking of diſtinct colours in all the planets, and even of colours as diſtinct, although leſs ſtrong, among certain of the fixed ſtars; and we find thoſe planets, and thoſe ſtars, which ſhed a light of the ſame tinge, placed in a kind of affinity together, and ſuppoſed to have the ſame influence over ſublunary things. We ſmile at this ſameneſs of influence, and we have reaſon, becauſe it is abſurd and idle to ſuppoſe, that any planet, or any ſtar whatſoever, has any influence; but we alſo ſmile at this pretended ſimiliarity of colour, ſuppoſing, that, excepting Mars, none of the ſtars, nor any of the planets, have any colour, much leſs any difference of colour: but in this we err. Let us look back to the earlieſt writings that have eſtabliſhed this opinion, and we ſhall find them confeſſing the origin of the obſervations from the Chaldæans; and we ſhall find them, after their Chaldæan maſters, aſſerting, diſtinctly and plain, that the light of Saturn is bluiſh, that of Venus yellowiſh,

lowiſh, and that of Mercury alſo bluiſh, but much more faint. The ruddy hue of Mars they alſo mention, and declare Jupiter to be the only planet that has a pure and untinctured light. In the ſame manner they go through the names of the principal fixed ſtars, mentioning them according to their places in the ſeveral conſtellations, and they tell us, that ſuch and ſuch of them are reddiſh, ſuch others yellowiſh, and others, which they alſo particulariſe, bluiſh. They ſuppoſe the ruddy ſtars to be of the nature of Mars, the yellow of Venus, and the bluiſh, according to their decree of tinct, of that of Mercury and of Saturn. The ſimilarity of their influence from this was a natural concluſion for people who had a firm faith in the doctrine of influences, and they have fallen into it: but while we reject this, without enquiry, (for it does not deſerve any) before we join in the common ſenſe of whim and error concerning the other, let us conſider the *place of view*, and enquire what is to be allowed for the difference between that, and the place where we live, who determine. We have a right to judge at once what was the effect of imagination in the doctrine of influence; but with reſpect to this variety of colour, it was an object of the ſenſes, of the eye-ſight, and they who aſſerted it muſt have ſome reaſon.

When we conſider the place of view all will be eaſy. The Chaldæans, we ſhall find, lived in an open country and pure air, their atmoſphere was a medium through which men muſt ſee more diſtinctly than it is poſſible to do in ours, and even if we had nothing farther in countenance of the obſervation, we ought to believe that they ſaw it, becauſe they diſtinctly deſcribe it, although we now, under ſo comparatively foul an atmoſphere we live, cannot. But there is more in favour of the doctrine; for even here, if we take a tolerable night, we can diſcern the yellowiſh tinge of the light of Venus, and if we take advantage of a very clear one, we ſhall ſee not only ſomething of the leaden hue in Saturn, and of the ſkyiſh colour in the bright Mercury, but even a difference in the tinge of the fixed ſtars. This is very little, and very faintly to be ſeen here, but ſtill it is ſomething, and it is enough to countenance all they ſay.

After producing this inſtance of an obſervation made by the unaſſiſted ſight, in which the place of view plainly makes a great difference, I ſhall call in another, in which the aſſiſtance of teleſcopes is concerned, and in which the difference is at leaſt as ſtriking, and the effect of determining, without calling in the conſideration, would be no leſs than cenſuring one of the greateſt men who ever wrote on the ſcience, for one of the greateſt things he ever did in it. This, as well as the other, will be treated of more largely in their proper places in the ſucceeding parts of this work, but, without all that preciſion, enough may be produced from them here to juſtify all that can be ſaid with reſpect of the importance of the place of view in the mere quality of the atmoſphere.

The great Caſſini, having, from the ſpots of Jupiter, in which he perceived a motion of revolution, and, after a ſtated time, a return to the ſame place of the ſurface, plainly proved the planet to have a revolution round its axis, ſet about the ſame form of obſervations with reſpect to Venus. He ſucceeded. As he had found that Jupiter revolved about his axis, and had, by the ſame means that led him to diſcover that, made out alſo the time or period of that revolution; ſo, with reſpect to Venus, the ſame ſpots, which, by their motion, proved that Venus did revolve alſo about her axis, by their return to the ſame place, proved what was the period of that revolution. Men had been convinced with reſpect to Jupiter, and they

they received, without enquiring thoroughly into it, (for that was very difficult) the doctrine with respect to the other planet.

After some years, Bianchini, an Italian, set about to observe Venus with the same attention; and he called in question, from his observations, not the doctrine of an absolute revolution about the axis in this planet, but the period of that revolution, which he made very different. Cassini was now dead, but he had left behind him a son not unworthy of such a father. This gentleman, eager to support the reputation of his father, and with the observatory at Paris, and all its instruments at his command, yet found it impossible to determine the point from observation. What he proposed to do was to repeat the observations of his father, to view those spots which appeared in his figures of the planet, and, on the return of which to their places, he had established the period of the planet's revolution; and to trace them in the same course, and see whether they did, or did not, return as he had laid it down that they did. The spots were not to be seen at all. It was impossible to suppose Cassini unfaithful in his accounts, and it was more impossible to imagine the instruments, which they used, less perfect than those he had employed; since the artists had improved, not lost ground, in the making them. The face of the planet however was not as he described and figured it; nothing of that precision and accuracy of form appeared in any of its variations: what were seen were not spots, but blotches, faint, irregular, and indeterminate, and insufficient to the purpose. In short, the face of the planet appeared there, as it does to us at this time, very beautiful, but not at all determinately marked with spots. It would have been easy to have determined, upon this disappointment, that Cassini was a deceiver, and that Bianchini, who pretended to accuse him of error, was not any thing better; but the *place of view* determined what to judge. Cassini had made his observations, not in France, but in Italy, and Bianchini had also made them there. So much difference was there therefore even between France and Italy, that what could be seen most distinctly in one of those countries, was quite invisible in the other.

Such are the absolute differences arising from the different place of view, when we make the same observations, and, as was hinted before, the very position of the person making the observation, is also to be considered in many cases before we come to a determination. It is very common to speak of a phœnomenon as being on the right, or on the left, in the heavens; but, unless you consider who it is that speaks, it will be as easy to err as if in the most remote place, although this regards only the direction; for the right or left of heaven may signify every part of it, and be expressive of every point of the compass, according as the person changes place who makes use of the word. But there is a certainty to be obtained in this, by observing what, and who it is that uses the expression. Thus, if it be an astronomer speaks, his eye being always turned to the observing stars as they come to the meridian, he naturally turns his face south, and therefore the right, or right hand part of heaven, is the west; if it be a geographer who speaks, we know that he always supposes the face turned to the north, and therefore with him the right, or right hand part of heaven, is the east. When we read the antients, if it be a poet who is delivering the sentiments of an augur or soothsayer, when he says it thundered to the right, or that bird flew to the right of heaven, the term right here means the north, for they directed their faces always toward the west, the place of those

fortu-

fortunate iſlands ſo celebrated in their compoſitions.

Thus we ſee that the place of view, and the direction of the eye in viewing, are of the greateſt conſequence to be known, in order to determine, with any degree of candour, or of certainty, with reſpect to what is delivered to us on the obſervation of others: ſince the latter may lead us to look to a wrong part of the heavens if we make any error in it, and the former make us doubt what we ought to receive upon the firmeſt credit, merely from the diſadvantages under which we make the obſervation.

After thus much with reſpect to the particular places of view, and their conveniences and inconveniences, it may be proper to return to the general effects ariſing in this reſpect from the ſpherical figure of the earth. This very frequently renders diſtant objects inviſible to us, while their diſtance would not make them ſo. In open countries, objects, that are very remote, and yet not too remote for the eye's diſcerning them, are not viſible from the ground, but become ſo when the perſon, who looks for them, aſcends the ſteeple of a church. When there are in this caſe no intermediate inequalities of the ſurface of the earth, there is nothing to occaſion this advantage of an elevated place of view, and diſadvantage of a lower, but the abſolute convexity of the earth, which, though it be not a very great thing within that diſtance that comes under the reach of the eye, yet it is enough to effect ſuch an alteration.

But if the obſervers had been inclined to doubt, that the impediment in this lower place of view was particular, and not general, and that it aroſe from ſome partial elevation of the ground between, which was only ſuppoſed to be level, and not from the abſolute convexity of the ſurface of the earth, he may be ſet right by removing the place of view to the ſea; for that, as a part of the terraqueous globe, has the ſame general convexity with the land. He will find, that the ſailor upon the top of the maſt ſhall ſee the top of the maſt of another, before he who is upon the deck has any view of it. The diſtance between his eye, and the remote ſhip, and between the ſailor's eye, and that object, is the ſame: to what then can his not ſeeing it, and the other ſeeing it diſtinctly at the ſame time, be owing, but to the convexity of that part of the ſurface of the ſea, that is between the two ſhips, and which is not equal to the height of the maſt from the deck of the ſhip. There are thoſe ſo unexperienced in the laws of nature, and the conſtruction of the globe they inhabit, that it will be hard for them to conceive a part of the ſea, at a ſmall diſtance from them, to be higher than their eye, ſince they will think it muſt, if it was ſo, overflow and drown them; but that the whole body of the ſea riſes thus in the ſame manner as that of the earth, and is of the ſame ſpherical figure on the ſurface, is very certain, and the cauſes of its not overflowing the land at its edges are very well known, and are ſufficiently explained in their places in this work. But taking this for granted, (as it is not here a place to prove it) all is eaſy. Let us, if the two former inſtances be inſufficient, remove the place of view from the ſhip to the land, but ſtill keeping the ſea between the eye and the object, as the ſwelling, or convexity of that fluid is the difficulty. Let us ſuppoſe a perſon on the ſhore looking for a ſhip, which, coming toward it from the remoter part of the ſea, if the ſurface of the ſea were a plane, the body of the ſhip, being the largeſt part of it, would be ſeen firſt, and from the greateſt diſtance, and the maſts would become viſible afterwards as it came nearer. But this is not the caſe, for although

though naturally larger objects are visible at a greater distance than smaller, yet, in this case, the first thing that is seen of the approaching ship is the top of its mast rising, as it were, out of the midst of the water. As the ship continues to advance, this becomes longer and longer, and, by degrees, shewing itself to its bottom, the deck, the sides, and the whole body of the ship are seen; this must be the case if the sea be convex on the surface, seeing, that, at the first, the ship is behind a part of that convexity, and it must, by degrees, become visible as it advanced up it. This is the case; for the bulk, or body of the ship is out of sight, while it is yet within a distance at which it might be seen, for the mast of the ship is at the same distance, and is seen; therefore this being the case, the surface of the sea is convex. In the doctrine of what regards the place of view, this convexity of the globe has a great part, and consequently it becomes necessary to establish it to the unexperienced upon the most unexceptionable foundation. In fine, whatsoever observations are made, from whatsoever part of the globe of the earth be they, with respect to the heavenly bodies, or with respect to things on earth, the appearances are all the same that they must be, if they were seen from a part of a globular surface; and, consequently, we should find it necessary to conclude from this, that the earth was globular, whether or not there were any other proof of it.

After thus much, as to the general place of view, from whence we look upon the heavenly objects, that is, the general globe of the earth, and the particular inconveniences, and the particular advantages, respecting particular places, we may come to the usual divisions, the terms of which occur continually in the accounts of observations, and are unintelligible, without some previous general knowledge. The man who, unacquainted with the principles of a science, reads the explication of some term of it, detached and unconnected with all other matter, will forget as soon as he has read it; but if some general principles are laid down with it, the sense will be imprinted on his memory, because the words have been addressed, not to the retentive faculty only, but to the understanding.

Astronomers, to define what are the several places of view upon the surface of the earth, conceive certain imaginary circles to be described upon it, and as these are only imaginary on the earth itself, howsoever real some may appear upon the globes, it is easy for them, by continuing the line that describes them through the air, to make certain corresponding circles in the heavens; this is one of the great steps in the science, and, beside making them able to ascertain the place of view, with all the necessary precision, it conveys, without the formal recital of the terms, an idea of its correspondence, in some degree, with the heavens.

Among these there is one, which is not of the number of the fixed ones, but changes with every place of view, or every part of the globe's surface on which the observer stands, and which is one of the most frequently named, and the most important to be rightly understood, the horizon; in order to this we are to understand, that there are two circles, properly speaking, called by this name, but they are distinguished by added epithets, the one being called the sensible, and the other the rational horizon.

Whensoever a person stands upon the surface of the earth, a circle being drawn, the plane of which touches the surface of the earth, in that very spot on which his feet stand, and continued to the heavens; this circle is the sensible horizon of that place, and is what is

to be called the ſenſible horizon by that ſpectator. Thus, if a man ſtanding upon the flat ſtone of a pavement, conceives that ſtone to be extended on every part till it reaches to the ſtarry heavens every way, yet retaining its flatneſs throughout, that ſtone, ſo extended, will be the ſenſible horizon of that obſerver; and whatſoever ſtars are above its verge will, with reſpect to him, be above the horizon, and whatſoever ſtars are below it will be below the horizon.

The rational horizon is a circle of the ſame kind, but the plane of which paſſes not through the ſurface of the earth, at the obſerver's feet, but through the centre of the earth, parallel to the plane of the other, and is in the ſame manner with that extended every way to the heavens: concerning this they ſpeak as concerning the other, or without confuſion, they may be ſpoken of conjointly. It might appear from the bigneſs of the earth, and the quantity of its ſemidiameter, (for all that meaſure is the diſtance between the ſenſible and the rational horizon of any place of view) that they muſt be very remote from one another in the heavens; but it is otherwiſe in the obſervation. Notwithſtanding that the globe of the earth appears a great thing to us who inhabit it, it is ſo minute a ſpeck, ſuch an abſolute point with regard to the univerſe, that the difference is nothing. In effect, the rational and ſenſible horizon, however remote the points through which their ſeveral planes paſs, may be to us who ſtand upon the earth, yet although they run parallel all the way, and are as diſtant at the heavens, in reality, as they are here, do, in all reſpects, with regard to obſervation, coincide, and become one line there. The diſtance of the ſtarry heaven is ſo great, that the great ſpace between them is quite inſenſible to us, nor can be diſcovered by any obſervation. It is evident from the laws of optics, that the more remote theſe parallels run, the leſs and leſs will become the diſtance between them, and that, at a due diſtance, they will come together: and it is equally evident, that the ſtarry heavens are at this, and much more than this due diſtance for their coalition; for it is a certainty found by all obſervation, that the whole earth is a point, and no more, to the expanſe of the ſtarry heavens. But though the magnitude of the earth is nothing, with reſpect to the extent of the heavens, yet to ourſelves, who inhabit its ſurface, it appears, as it is, a very conſiderable thing, and by the interpoſition of but a ſmall part of it, or the removal of the place of view from one part to another of its ſurface, hides or diſcovers certain parts of the heavens, or ſhews them in certain manners, and is indeed the great thing to be conſidered in all our obſervations: for the ſame ſtars will appear to riſe and ſet in a very different manner, and the whole face of the heavens will appear very different to him who views it from within the polar circle, from what it does to him who views it from ſome part of the temperate zone to the north of the tropic, and yet very different here from what it does to him who ſees it from ſomewhere ſouth of the tropic of Capricorn. The plane of an horizon, or circle, thus continued from the part of the earth on which we ſtand to the ſtarry heavens, divides the whole heavens into two hemiſpheres, the one of which is in all parts naturally viſible to us, and the other in all its parts naturally inviſible. Theſe are the terms alſo under which they are expreſſed; for that part of the heavens which is hid from us by the earth's intercepting our view, is diſtinguiſhed by the name of the inviſible hemiſphere, and that which is above the plane of the horizon, from its being neceſſarily in our ſight, is called the viſible hemiſphere. The

terms

terms upper and lower are alſo very naturally uſed in this ſenſe, that which is beneath the earth, being naturally called the lower hemiſphere, and that which is above the plane the upper hemiſphere: and, with reſpect to this, it is very natural alſo to divide the ſtars into two parts for any given time, by the limb of this circle, and ſay, that ſuch and ſuch ſtars are above, and ſuch and ſuch ſtars are below the horizon. This ſituation of the ſeveral ſtars, with reſpect to the horizon, is the moſt vague and uncertain imaginable, being relative only to the preſent movement, and to the exact ſpot on which the perſon ſtands. No ſtar is to be ſaid to be abſolutely above, or below the horizon, ſince, from the revolution of the earth, the whole multitude of them are, with reſpect to the ſame place, continually removing, and thoſe which were at one hour below, are, at the next, above the horizon, and that which reſpect to the places, as the horizon, is different in every *place of view*. Thoſe ſtars which are above the horizon are below, and thoſe with are below it are above that in ſome other part of the earth, or from ſome other point of view, and that at the ſame moment; ſo that the term above and below the horizon, when applied to ſtars, is to be underſtood of a certain moment and a certain place, both abſolutely fixed, or elſe it can have no meaning.

When a man ſtands upon an open plain, and has nothing to intercept the view of the heavens any way; if he caſts his eye all round him, he will ſee the view terminated every where at an equal diſtance, by the meeting, or apparent meeting, of the heaven and earth. This circle which terminates his view, and is the place of this meeting of the heavens and the earth, is his horizon, if there were any difference between the ſenſible and the rational horizon, this would be the ſenſible one, becauſe it is a circle, the plane of which paſſes through the part, where his feet touch the ſurface of the earth; but as there is no difference in the extent of this circle, and that whoſe plane paſſes through the centre of the earth, where both reach the heavens, the rational and ſenſible being then united, what he ſees from the ſpot where he ſtands is the rational, as well as the ſenſible horizon, and may, in ſimple terms, be called the horizon of that place of view. But, if there were any diſtinction, the regard would be required to be had to the rational, and not to the ſenſible horizon; for whenever we meet with the term horizon in the writings of aſtronomers, they intend to be underſtood as ſpeaking of the rational horizon, unleſs they diſtinguiſh what they mean by adding the word ſenſible to the general term.

From the obſervation, that from every ſpot of the earth, the horizon is a different circle, and is not the ſame in any two of them, it appears, that the earth is round, or ſpherical; for it is evident, that the horizon of every place is different, and it is as evident, that if the earth were a great plane, the horizon from every part of it would be the ſame; and that, in this reſpect, all places of view would be alike, whereas it is in this reſpect that they differ ſo very eſſentially.

It is not only in reſpect of the place of view that the horizon is a circle of this great conſequence with regard to aſtronomical obſervations: but, as it is a great circle of the ſphere, it muſt divide the heavens into two equal parts from its ſituation, and, in conſequence of that, it muſt alſo divide into two equal parts all thoſe great circles of that ſphere which are interſected by it; this is a point of great conſequence alſo in the adjuſting of aſtronomical obſervations.

Wheresoever the person stands, who views all about him this circle of the sensible horizion, there will be two poles of it; these are distinguished by peculiar names, that they may be spoken of the more familiarly. They are situated, the one over the person's head, and the other under his feet, and are called the zenith and the nadir. The zenith is that above his head, and the nadir that under his feet; and these also are assistances, and great ones, in determining what are the places of view of the several phœnomena of the heavens.

PLANE. An epithet applied to surfaces when they are flat, or neither raised into convexity, nor depressed into concavity. *This is farther explained under the term* SURFACE.

PLANES. A line falling strait on a plane is said to be perpendicular to it; if it touch it in a point and slant, it is called inclining, if extended equally over it, it is parallel to it. A point is said to be in a plane produced, when it is in such a place, that if the plane were extended, or continued, it would pass through it. A point is said to be elevated above a plane, when a line, drawn from the point to the centre of the plane, is either perpendicular or inclined to the plane. Parallel planes are like parallel lines, such as, if extended ever so far, will always keep at the same distance, and can never meet. The distance is measured by strait lines, let down from plane to plane, and the equal length of these lines proves the parallellism of the planes. The two opposite sides of a cube, or die, are parallel planes. A wall upon a pavement represents an upright plane, standing upon another plane; two such planes are said to be perpendicular to one another, or to intersect each other at right angles. When a wall leans it represents one plane standing obliquely upon another; the one is said to incline to the other, and the angle, contained between the two surfaces of the planes which are nearest to each other, is called the angle of inclination of that plane. If two planes, which are not parallel, be extended, they will intersect each other, somewhere in a right line, and this line is called the common section of the two planes. The inclination of two planes to one another is measured by an angle, contained between two right lines, which are drawn upon the planes perpendicular to their common section, and which meet in a point of it. If two planes intersecting one another be imagined to move upon their common section, the wider the planes are opened asunder, the greater is the angle of their inclination, and this will encrease till they are one perpendicular to the other.

PLANE FIGURE, *irregular*. A plane figure consisting of various sides, and various angles, which are unequal one to the other. The astronomer will often find it necessary to determine the area of such a figure as this; it is to be done by the assistance of a division of its surface into triangles; these triangles must be formed by drawing lines from one angle to another. When this is done, the area of these several triangles is to be found by the rules prescribed under the article TRIANGLE; and, when this is done, these several sums are to be added together, and the product gives the whole area. On this simple principle, beside the use it is of to the astronomer, depends the art of surveying.

PLANETS. Although the planets differ very widely from the fixed stars in the nature of their light, yet they do not differ all equally from all the fixed stars, The consequence of the

the ſtars being bodies luminous in themſelves, and of the planets, ſhining only with a borrowed light, is, that the one are more vivid, and the other more calm and placid, and that the eye bears the light of the latter much better than that of the former, as it bears with great eaſe to look upon the moon, though very near, and very bright; and cannot bear at all to look upon the ſun, although very diſtant. But the ſtars have differences of light and radiance among one another, and they have even differences in the colour of their light. Although this is not ſo obvious as many other of their characters, it has been diſtinguiſhed by ſome of the old obſervers, and the ſeveral colours noted down by ſome of them. This alſo is the caſe with reſpect to the planets, and in a much greater degree, and we can very eaſily account for it. When we conſider this variation among the fixed ſtars, which are in themſelves luminous bodies, we muſt refer the difference of colour to the different nature of the inflamed materials, and the difference in brightneſs to the greater degree of purity, or to their greater or leſſer quantity of ſpots. We ſee the ſun's face is ſubject to theſe, and as the ſtars are ſuns, they alſo, we need not doubt, are ſubject to them; and as theſe are in greater or leſſer quantity, the ſurface of the ſtar will be more or leſs bright. With reſpect to the planets the account is yet eaſier, we ſee that they are cold and opake bodies, they reflect the light which they receive from the ſun, and as they reflect all the rays of that light, not any particular aſſortment of them, the colour is white, that being, as we know by experiment, the reſult of all the rays reflected together, all the colours blended in the reflection of light making white: in this however there is ſome little variation, though all the planets reflect in general all the rays of light, yet there are ſome of them which have their ſurfaces ſo formed that they do not reflect all with this perfect equality, but one, ſomewhat more of thoſe of one ſort or colour, and another, thoſe of ſome other ſort or colour in the greateſt abundance; it is this which makes them appear to us of different colours, as they in truth do, though the difference in all, except Mars, be ſo little, that, in compariſon of their difference of colour from him, they all appear white.

The colour of Mars is reddiſh, or ruddy, very plainly, and very ſtrongly ſo, inſomuch that, by this tinge alone, that planet may be diſtinguiſhed from all the ſtars in heaven. The light of Jupiter is neareſt of all a perfect aſſemblage of all the rays, and it is therefore Jupiter appears of a pure unſtained and ſilvery white. Venus, with all her brightneſs, has not the pure colour of Jupiter, but a curious eye will, at all times, diſtinguiſh her to be a little tinged with yellow, approaching toward what we expreſs the paleſt ſtraw colour, or what the ladies expreſs in their ſilks by ſtraw colour, ſhot with white. Mercury, with all his brightneſs, has a tinge of blue, but it is very faint, and leſs perceptible than that of any other; and Saturn has alſo a dead tinge of the ſame kind, but in that planet it is mixed with the yellowiſh, and approaches, though in the fainteſt manner in the world, to what is called glaucous, or the aqua marine colour. Some have ſuppoſed this dead bluiſhneſs of Saturn to be owing to his immenſe diſtance; but they err: for Mercury, which is ſo very near the ſun, abſolutely has it alſo.

As we find common obſervers quite unappriſed of this, we may conceive, that it is, at the beſt, faint, and that it requires a very nice and cloſe inſpection to diſcover it; to this we are to add alſo, that England is not the moſt favourable place in the world for the obſervation. The air of Italy is much clearer, and

ſuited to all nice diſquiſitions, which reſpect the heavenly bodies much better than that of England. We find by the obſervations of the planet Venus, made in Italy by Caſſini, and in vain attempted by his ſon at Paris, when his diſpute with Bianchini made it neceſſary, as far as might be, to repeat them, that, even that country, more favourable by far than this is, yet leſs ſo than Italy; and we are not to wonder, that to the naked eye alſo, that air is more favourable for obſervations. It is from the Chaldæans that we have the firſt hint as to this difference of colour in the planets, and we muſt be ſenſible that it will be leſs ſeen here.

As the Italians were the firſt among the moderns who obſerved the different colours of Mercury and Venus, the Chaldæans were, as far as we know, the firſt who obſerved that there was this difference in the hue of the fixed ſtars. It is not a wonder that they were happier than all other people in theſe obſervations. They were ſituated in an open country, and had a very clear air, and they were bred, from generation to generation, aſtronomers, if ſuch obſervations, as we find recorded of them, give a title to that name. They connected together the ſciences of aſtronomy, ſuch as it then was, and of judicial aſtrology. They pretended to tell events by the ſtars, and not only preſaged, (as they would have it believed) eclipſes, but earthquakes. They had a continual recourſe to the ſtars on all occaſions, and, as they had ſuch opportunities of viewing them, it is not a wonder they made out all their minuteſt differences. They ſuppoſed the differences of colour were owing to peculiar commixtions of elements aſcending from the earth to the ſtar, and that thoſe elements were peculiarly affected by the ſtar on all occaſions, and hence they preſaged events from the preſiding power of ſuch and ſuch ſtars. In this we find, by their own accounts, they were directed principally by the difference of their colours.

Thoſe, who have given into the follies of judicial aſtrology, have borrowed many of their opinions from the old Chaldæans, for errors and follies have been tranſmitted down from age to age, and often by thoſe who ſcarce underſtood the words in which they delivered them. We find the aſtrological writers of later times arranging the fixed ſtars into certain ſeries, of which we have little idea, calling ſome of the nature of Mars, others of the nature of Venus, others of Jupiter, and others of Mars and Mercury. They preſage from the influence of theſe as they would do from that of the planets, to which they are, as they ſay, allied; and this alliance, whether they know it or not, (for poſſibly the moſt of them take it only by hearſay) is founded on the different colours of the ſeveral fixed ſtars, obſerved firſt, and that with the ſame intent, by the Chaldæans. Thus thoſe ſtars, which have a reddiſh caſt, are ſaid to be of the nature of Mars; thoſe, which have a tinge of yellowiſh, of the nature of Venus; thoſe, which are bluiſh, of the ſame with Saturn; and thoſe, whoſe light is quite pure, to be of the nature of Jupiter. All this requires an eye of diſcernment, and a great deal of attention. When it is diſcovered, it will be found very faint, but very different in its nature in the fixed ſtars and planets; the colour of the fixed ſtars being like thoſe thrown out in radiation from a diamond, or as if only tranſitory and accidental; thoſe upon the planets, like the tincts upon a juſt ſtained cloth, permanent and ſteady, but very light, and eaſily overlooked.

The antients worſhipped the planets among the reſt of the hoſt of heaven. This ſpecies of idolatry was called Zeclicifm, and was, doubtleſs, the earlieſt in the world. The ſeveral

veral planets, as alſo the ſun, moon, and ſtars, were underſtood to be either in themſelves of a divine nature, or the habitations of ſome deities. The planets were the firſt of the heavenly bodies honoured with this adoration; they were found to move, and that with a perfect regularity, in the wide ſpace of the heavens; and it was not eaſy for thoſe, who were unacquainted with all the laws of the univerſe, to conceive how this could be, otherwiſe than by their having a ſuperior Being, which guided and directed them. Some ſuppoſed that they were themſelves a kind of animals poſſeſſed of a living ſoul, and moving at their own pleaſure; and others, that the ſupreme Being had lodged in each of them a portion of his own eſſence. From this they were ſuppoſed to influence, and in ſome degree ſuperintend, the affairs of mankind, and it was not ſtrange, that, under this perſuaſion, men ſhold worſhip them. The Egyptians were devoted to this ſnperſtition, and their Iſis and Oſiris were no other than the moon and the ſun adored under a variety of forms; Oſiris was the ſun, and a male deity; Iſis the moon, and a female; but in this they were not fixed, for they ſometimes make their Iſis male. In this they ſtill mean the moon, only conſidered in different capacities.

PLEIADES. The Greeks, who will father ſome part of their fable upon all the conſtellations, may very well be expected to have adapted ſome ſtory of it to this cluſter of ſtars which was no conſtellation originally, but was only honoured with a name by themſelves. They tell us that theſe Pleiades were originally ſeven Dodanian nymphs, who had ſerved in the office of nurſes to Bacchus; they give us their names Ambroſia, Eudora, Pheſyle, Coronis, Polyxo, Phæo, and Thyerce. Theſe, they tell us, were all baniſhed by Lycurgus, and that they all fled, except Ambroſia, to Tethys, or, as others ſay, to Thebes, where they delivered up their charge to Juno, and that, for their ſervices, they were afterwards taken up into the heavens, and each converted into a ſtar, where they ſtill ſhine. They were called Pleiads, we are told, becauſe they were the daughters of Atlas and Pleione, one of the daughters of Oceanus. They ſay that this nymph bore to him fifteen daughters, of whom theſe ſeven had this title from their mother; and five others, on account of their love to their brother Hyas, were called Hyades.

The Pleiades are of the number of thoſe ſtars particulariſed in the ſcriptures, and they are ſo few which are ſo, that it would be unpardonable not to enquire into the real hiſtory of them. The thought may ſeem needleſs to thoſe who are content with the words of the bible, as they find them in the Engliſh verſion, nay, it were not going ſo far to ſay, that, if the Septuagint could be depended upon, there would be no room for farther diſquiſition, nor occaſion for enquiry; but that is not the caſe. The word Pleiades ſtands very fair in the ſeveral parts of the book of Job, and, where the conſtellation Orion is named, is always in company with it; and in Amos, where the ſame Orion is mentioned, the other conſtellation, which is named with it, is called the Seven Stars, which we very well know to be another name of the Pleiades. Thus ſtands it in the Greek, the Latin, and the Engliſh bibles; but the queſtion is, What is the caſe in the Hebrew?

The words, which are rendered by theſe conſtellations, are, in the original, Chimah and Cheſil; but upon what authority are they thus rendered? The beſt we can give is that of the Septuagint verſion, and there is much uncertainty with reſpect to the aſſurance we would allot from that. In the firſt place, the credit of

that vefiorn depends upon its having been made by the concurrent opinion of thofe feventy learned and wife men whom Ptolemy engaged in the undertaking; but if we look into the beft authorities, perhaps we fhall find reafon to queftion whether they tranflated the whole bible or not; if they tranflated only a part of it, that part was the beginning only, the books of Mofes, and, if fo, they have no fhare in rendering thefe words in the Hebrew by the names of thefe conftellations, for they are not named in the books of Mofes, nor could be, for it is not to be imagined that writer could fpeak of any conftellations at all, fince it is not to be imagined that there were any conftellations formed in his time.

If this be allowed, we fhall not well know on whofe authority we build the opinion that the Pleiades are named in fcripture, for it is on that of the tranflators of thofe books only, and if they were not thofe whom we underftand by the Septuagint authors, we know not who they were. That the Hebrew, in the places where we hear of the Pleiades and Seven Stars, ufes a word that fignifies fome conftellation is beyond doubt, but the queftion is, whether that word meant what we underftand by the Pleiades. Thofe, who fuppofe the book of Job to have been written by Mofes, will be ready to object to the obfervation juft made, that Mofes could not name any conftellations, but thefe are but flightly acquainted with the hiftory of the feveral parts of the Old Teftament; far from having them fo old as the time of Mofes, the book of Job was doubtlefs written in the time of the captivity of the Jews, that is between five and fix hundred years before Chrift; and as we know that conftellations were, before that time, figured among the Egyptians, and indeed about, or not long after, that time, introduced by them among the Greeks from the labours of thofe who travelled from that country into Egypt to improve their knowledge, there is nothing wonderful in finding them mentioned in this book. The other parts of the facred writings in which they are named, that is, in which any of the conftellations are named, are the prophecies of Amos and Ifaiah, and thefe we know, far from being of the early period of the books of Mofes, are not more than between feven and eight hundred years earlier than the Chriftian æra; thefe prophets having been cotemporaries, or very nearly fo, and both, according to their own accounts, having prophecied in the reign of Uzziah, who began his reign in the year 3899 of the Julian period, and died 3950. Thefe were therefore writers who might very well mention conftellations, though we know not how to imagine Mofes could do fo, and they were the moft likely to name thofe which were then moft known and moft in ufe. It was a very early period in aftronomy, and although we imagine fome conftellations to have been formed, we do not imagine all to have been fo, not the feventy that are now in ufe, for many of thefe are very modern; not the forty-eight old ones named by Ptolemy, for they were formed but by degrees, and brought in the fame manner by degrees into Greece, the moft ufeful firft, and afterwards thofe of curiofity. The moft ufeful are only four or five, that is, the moft immediately ufeful, and thofe which hufbandmen and failors had recourfe to; and thefe were doubtlefs the firft formed, and the moft generally known. Poffibly the writers of this part of the fcriptures lived at a time when but a few more than thefe, (poffibly when no more than thefe) were known: if fo, thefe were the only ones they could mention, or, if it were otherwife, when they had the whole heavens to chufe out of, and there were fo many conftellations before them, in fpeaking of the greatnefs and goodnefs of the

Deity, they would naturally ſelect, to illuſtrate thoſe attributes, ſuch of the conſtellations as were moſt conſiderable, moſt known, and of moſt uſe to mankind.

Theſe are reaſons why four or five conſtellations only ſhould be named in the writings of the Old Teſtament, and we find no more are ſo. As to the crooked Serpent mentioned in the book of Job, notwithſtanding the ſtrange blindneſs and perverſeneſs of thoſe commentators who have ſuppoſed the zodiac and the Milky Way intended by the name, the very epithet tortuous, for that is the ſtrict ſenſe of the Hebrew, and it is ſo tranſlated by many, ſhews that it could mean only the conſtellation Draco near the north pole; the Lucidus Anguis of the Latin poets; and a conſtellation to which the ſailors and the huſbandmen of the times had regard. As to the others, the tranſlators of this part of the Hebrew bible, whoever they were, ſaw only ſuch a number mentioned in thoſe early writings, and, not underſtanding what was meant by the names, (for this is not too much to ſay, even if we allow the authors of the Septuagint to have tranſlated thoſe books) they had recourſe to the early Greek writers. They found theſe, in the ſame manner, mentioning only four or five conſtellations, and thoſe the uſeful ones; they ſeem to have taken, for want of a more perfect knowledge, theſe upon truſt, as the ſame with thoſe four or five of the ſcriptures, and to have put their names where they found thoſe which they did not underſtand in the Hebrew. The queſtion was, ſuppoſing thoſe four or five conſtellations, mentioned by Homer and Heſiod, and the reſt of the old Greeks, to be the ſame with thoſe named in the ſacred writings, which names in the Greek anſwered to which in the Hebrew. This alſo was conjecture; but they found among the Hebrew two always mentioned together under the names of Chimah and Cheſil; and in the ſame manner they found among the Greeks two alſo frequently accompanying one another; theſe were the Pleiades and Orion; they therefore put theſe in all places for the Chimah and Cheſil of the Hebrew text, and thus far they happened to be right, that one of theſe two names did belong to one of theſe conſtellations; but, acting only on conjecture, they gave it to the wrong of the two. They have always rendered Cheſil by Orion, and for Chimah they have given the word Pleiades; thus, they ſay, "Canſt thou "bind the ſweet influence of the Pleiades, or "looſe the bands of Orion?" In this part of the original it is Chimah, whom Job is aſked if he can bind, and Cheſil if he can looſe, and it is Chimah, and not Cheſil, that is the name of Orion; ſo that it ſhould be, "Canſt thou "bind the ſweet influence of Orion, or looſe "the bands of Cheſil?" Whether this be the Pleiades or not, is the buſineſs of the preſent enquiry.

It has been already obſerved, that there is great doubt whether the book of Job, and thoſe of Amos and Iſaiah, (in which three books alone this conſtellation Cheſil, which is rendered by the word Pleiades, or the Seven Stars, is mentioned) were tranſlated by the ſeventy men of learning, employed by Ptolemy to tranſlate the law. Probably they were not, for we find the books of Geneſis, Exodus, and the following, very well tranſlated, and theſe much worſe. There are many errors in Amos, more in Iſaiah, and, in regard to the book of Job, the very meaning is ſo often miſtaken, that no man can judge of it that does not read it in the original.

But ſuppoſing that theſe were tranſlated by the authors of the Septuagint, what reaſon can we have to place an abſolute dependance upon the rendering of theſe names of the conſtellations? The Jews were far from a learned, of

or a wiſe people, ignorance and obſtinacy make their character. They never paid any reſpect to the ſciences, even in their moſt flouriſhing ſtate. We have little reaſon to ſuppoſe they regarded them, when they were the ſlaves of another monarchy. They had enough to do to keep on terms with their maſters, and theſe very maſters were, for a great while, in no condition to ſtudy the ſciences themſelves; much leſs is it likely that a people, who were captives among them, ſhould. When governments are fluctuating, and ſtates in danger of revolutions, arms, and not arts, are the ſtudy of the people. It would have been inſolence in their ſlaves to have ſtudied the arts of peace, while they were enduring all the havock of war: and there was yet another reaſon, for, having themſelves a faith in aſtrology, they would have ſuppoſed theſe people conſulting the ſtars not out of a view to knowledge, but curioſity, to pry into futurity; and would have reſented the reſearches as ſo many inſults on their diviſions, and examinations into the time of their ruin. Theſe reaſons, the natural dulneſs, and incurioſity of the Jews, and their fear of offending thoſe, to whom they were accountable for all their actions, and who, being themſelves in a ticklиſh ſituation, would be ready to quarrel upon little occaſions, muſt be ſuppoſed to have prevented all the improvement of aſtronomy among the Hebrews during their captivity; and, after their reſtoration, they were no more at peace than they were during that period. They had not been at liberty, even if they had had inclination to it, to purſue the ſtudy of the ſciences; they were continually at war with one or other enemy, and no way ſucceſsful in their enterprizes. We find, even in their moſt quiet times ſucceeding this, no notice of their ſtudying the ſciences. Seminari[illegible] learning were ſcarce heard of [illegible] d where any thing, that had the face of erudition, was encouraged, neither hiſtory, nor philoſophy, nor the ſciences were conſidered; but all that was the ſubject of their diſquiſitions, was the ſenſe of ſome obſolete term in their books of the law, or the meaning of ſome word concealed in its conſtituent letters. Their language was, at this time, no longer in its purity, it was become a lingua franca, a mixture of twenty tongues, from the ſeveral people among whom they had lived; and it was not wonderful that diſputes ſhould ariſe about the meaning of certain terms of thoſe writings, which contained their precepts and inſtructions, delivered in their language, as it was written at the time of the greateſt purity it had ever known.

If we ſee the Jews in this light, and this is the exact and true light in which we are to ſee them, we ſhall not be inclined to pay the greateſt veneration to their knowledge in the ſciences, nor ſhall we wonder that thoſe, whom Ptolemy employed to tranſlate the bible, even ſuppoſing that they did tranſlate this part of it, might miſtake in rendering the names of conſtellations. Whoſoever they were that tranſlated Amos, Iſaiah, and Job, whether theſe ſeventy or others, we have not the leaſt ground to ſuppoſe that they knew any thing of the eaſtern aſtronomy, and it appears, by the tranſlations of theſe ſeveral paſſages, that they did not underſtand it. It is plain, from a thouſand proofs, that they acted by mere gueſs when they rendered Chimah and Cheſil by the Pleiades and Orion; and that they gave the name to that which was one of them, although they uſed it in the verſion, they applied it to the other. The very meaning of the word Chimah might have led them thus far, it ſignifies a giant, and Orion, that great figure in the heavens, has been call Al Gabbar by the Arabians, the interpretation of which is alſo a giant, and ſome have called it Gigas in Latin.

Upon the principles of this preliminary examination (and leſs than this would not have furniſhed ſufficient) let us enquire then what is meant by the word which has been rendered the Pleiades and the Seven Stars, and joined with the name of Orion in theſe ſeveral places. In order to this, let us firſt examine the paſſages themſelves, and the intent of the writers in them, ſeverally. The author of the book of Job, when he deſigns to deſcribe the majeſty and power of God, looks up to the heavens, and, calling in the conſtellations, their great furniture, and ornament, ſpeaks of him who made Arcturus, and Orion, and the Pleiades, and the chambers of the ſouth. In another part of the ſame allegorical work, the Creator of the univerſe is introduced himſelf ſpeaking, in the ſame reſpect, of theſe vaſt orbs, which ſhine in the expanſe of the ſkies: he calls upon man, who ſuppoſes himſelf of ſome conſideration, and aſks, whether he can do any of thoſe things which his hand is eternally regulating. " Canſt thou bind, ſays he, " the ſweet influence of Orion, (for that, as already obſerved, is the true tranſlation) " or " looſe the bands of the conſtellation Cheſil") for this, though called the Pleiades in the tranſlations, it may not be warrantable to call by that name here.

Before the author of the book of Job, whoſoever that was, we find the prophet Amos, for he lived undoubtedly ſome centuries before that writer, mentioning the ſame conſtellations, and in the ſame order, and under the ſame names. When he urges the Jews to repent and turn themſelves to their God, he does it on the great argument of the power and greatneſs of that Being; and when he would expreſs that greatneſs, he has recourſe to the ſame objects by which to point it out to them. " Seek " him who made Cheſil and Orion, (the Seven Stars and Orion is the Engliſh verſion) " and turneth the ſhadow of death into " morning."

If we content ourſelves with referring to the Engliſh bible, we ſhall find no more mention of this conſtellation: but, if we have recourſe to the Hebrew, we ſhall find that the word, which they have tranſlated Cheſil, occurs in Iſaiah, although it is not rendered the Pleiades, but, by a general term, *conſtellations*. The reaſon is alſo obvious, for the word, although ſingular in both places of Job and in Amos, is plural in Iſaiah; not Cheſil, but Cheſilim. They, who had tranſlated it the Pleiades, knowing that there could not be two conſtellations of that name, knew not what to do with the word, when they found it in the plural number, but rendered conſtellations without any peculiar appropriation. The prophet is denouncing the vengeance of God againſt Babylon, and threatning it with abſolute deſtruction; and to denote his wrath in this place, as the others, to ſignify his greatneſs and power in the former, he has recourſe alſo to the conſtellations which decorate the heavens. *Behold the day of the Lord cometh, cruel both with wrath and fierce anger, to lay the land deſolate. For the ſtars of heaven, and the Cheſilim thereof, ſhall not give their light. The ſun ſhall be darkened at his going forth, and the moon ſhall not cauſe her light to ſhine.* I have obſerved, that the word Cheſilim is rendered, in this place, conſtellations, and that from the perplexity of meeting with what they had rendered in other places by the name of a ſingle conſtellation now in the plural number. This might, indeed, well puzzle men who acted only on principles of conjecture, but perhaps the very occaſion of their difficulty may be that which will principally clear up the matter, when we ſet out on the right foundation.

There have not been wanting commentators upon theſe books of the holy ſcriptures of that

nation, who had moſt right to judge of the language and the meaning of the words; but, if we examine what theſe laborious triflers have left us, we ſhall only find conviction of what has been already advanced, that, of all people of the earth, the Jews knew leaſt of the ſciences; and were, by no means, either in their darker, or more enlightened periods, to be ſuppoſed judges of the aſtronomy of the early times, or able to determine what conſtellation was meant by any name of one that is found in the ſacred writings of their nation.

It has been already obſerved how they erred with reſpect to Chimah, which, being the real name of Orion, they tranſlated by the Pleiades; and though we have allowed them, that one of theſe conſtellations was deſigned by one of the two names, yet, after ſuch a miſtake in the application, we can, by no means, allow that their ſaying the other of the two belonged to the other conſtellation, is to be ſuppoſed of any weight, or authority toward proving it. The tranſlators, we plainly ſee, knew nothing what the word Cheſil meant, although they have tranſlated it Orion, and Chimah Pleiades, in two places, and the Seven Stars, which is another name, in a third; for they have made the ſame word indeterminately ſignify the conſtellations in general in another: and we ſhall find the commentators of the ſame nation, inſtead of attempting to diſcover their error, or to ſupport the truth of their expoſition, taking it for granted that they are right, and talking upon that which they allow to be right in ſuch a manner, as to convince the world that they knew nothing of the matter: or, if they broach other opinions, yet as far from truth in one as in the other.

Chimah has already been explained, it remains to ſee what they ſay of Cheſil. Among thoſe who eſtabliſh other opinions different from thoſe of the tranſlators, and will not have Cheſil to be Orion as they make it; ſome make it a ſouthern conſtellation, and others ſuppoſe it to be only a ſingle ſtar, the ſame with the Sohail, a bright and beautiful ſtar in the conſtellation Argo, or Navis, called by ſome Canopus. Others bring it back to the northern hemiſphere, and will have it to be a ſingle ſtar in one or other of the conſtellations there: but they are ſtill puzzled to know what Iſaiah means, who threatens the darkening of it, and ſpeaks of it in the plural number. Some of them even ſuppoſed it to be Aldebaran, or the ſtar in the Bull's eye; others, that in the Spica Virginis; others, Sirius; and again, others, that in the conſtellation Scorpio, called Cor Scorpionis, or the Scorpion's Heart. In ſhort, ſuppoſing that Cheſil muſt mean ſome conſpicuous ſtar, theſe have gueſſed, one after another, at almoſt all the ſtars of the firſt magnitude in either horizon; and the others, when they have allowed Orion to be meant by it, have ſpoken of Orion as ſituated ſometimes in one, and ſometimes in another part of the heavens; and when they have readily agreed to Chimah's meaning the Pleiades, have talked of them alſo under the name of the Seven Stars, and have ſhewed that they knew not what even the Seven Stars meant, but have placed them ſometimes in the conſtellation Taurus, and ſometimes near the north pole, underſtanding ſometimes the Pleiades, and ſometimes the Septemtriones.

As we find that no dependance is to be laid upon the tranſlators, nor any light to be obtained from thoſe who have attempted to comment upon the paſſages where theſe are mentioned; let us conſider what may be done by an attention to the paſſages themſelves. It often falls out thus, that, where no other means are of uſe, an author explains himſelf; and we are the more fortunate in this reſpect, as it is not only in one part of the

ſcriptures,

ſcriptures, or in one book of them, that the two conſtellations, Orion and the Pleiades, or the Chimah and Cheſil, of the Hebrew, are mentioned, but in different places, and by different writers; by Amos, by Iſaiah, and by the author, whoſoever that was, of the book of Job. Let us conſider the ſeveral circumſtances under which the word Cheſil is mentioned, and ſee whether they will make it ſeem to agree either with the Pleiades or Orion, for, if it would do for either, we would forgive the miſ-placing of the words.

Amos, when he would expreſs the greatneſs of the Deity by the works of his hands, calls in, upon that occaſion, the names of two conſtellations, and names the God of heaven and earth as him who made Chimah and Cheſil. Doubtleſs, he has named, on this occaſion, two which were very conſiderable, ſince he had more to chuſe out of, and he ſelected theſe.

Iſaiah, when he denounces the vengeance of God againſt a ſinful people, ſays, as a part of their puniſhment, that the Cheſils ſhall not ſhine. It appeared, by the firſt quotation, that Cheſil was a conſtellation of vaſt conſequence, and this confirms it, ſince it would neither have become one of theſe writers to name the making a conſtellation which was of little importance, as one of the great works of the Almighty, nor the other to have threatened a people with the taking away the light of a conſtellation as a puniſhment, unleſs it were a very conſiderable and important one. We find by both, therefore, that Cheſil was a conſtellation of great conſideration; and we find by the latter, that it was not one, but two, or that there were two conſtellations, both of the ſame name, and both of this importance.

In the firſt place, in the book of Job, where they are mentioned, they are named as inſtances of the power and goodneſs of God in their formation; and thus the opinion of Amos and Iſaiah, as to Cheſil being a conſtellation of importance, is confirmed; the words are, Who made Aiſh, Cheſil, and Chimah! that is, as it is tranſlated, Arcturus, Orion, and the Pleiades.

But the laſt place in Job is more particular; the words are, "Canſt thou bind the ſweet "influence of Chimah, or looſe the bands of "Cheſil." This implies ſomething in the form or figure of the conſtellation, or conſtellations, Cheſil, to which the word untie could have reference. Let us ſum up the whole together.

Cheſil appears to be a conſtellation of vaſt importance to mankind, it appears to be one which is not ſingle, but which has another of the ſame name with it, and it appears to be one which has ſomething about it that may be expreſſed by the words cords, or bands, and tying.

The firſt article, its importance, will turn our eyes directly towards the north pole, the ſtars about which were of the moſt immediate uſe to mankind, as they were thoſe by which people directed themſelves in ſailing, and not only in that, but in travelling over the great deſerts of Arabia, and other countries where there were no marks to direct them in the way. This all the old writers tell us, and this places the ſtars about the north pole as thoſe which were moſt important to mankind; they were the moſt likely to be firſt formed into conſtellations becauſe of their utility, and thoſe conſtellations were what would be moſt probably referred to, for the ſame reaſon, by thoſe who mentioned any of them at all, as inſtances of the power and goodneſs of God.

We are thus referred, by the firſt conſideration, to the ſtars about the north pole, and then, in conſequence of the ſecond, the plural

uſe of the word, we are to ſeek for two conſtellations of the ſame denomination. There are two ready, the Greater and the Leſſer Bear, and theſe are alſo ſuitable in the other reſpect, inſomuch as they are, and always were, eſteemed of the moſt importance in the heavens: and the taking away their light, or the making them ceaſe to ſhine, muſt have been of the greateſt ill conſequence to a trading people.

The third article remains. Theſe conſtellations muſt be two, and they muſt be conſiderable, the two Bears are ſo. But they muſt be alſo ſuch as in their figures have ſome reference to cords, or tying, or might juſtify the uſe of ſuch words in ſpeaking of them. Now we are to allow, that a bear has no more to do with cords than the lion, or any other of the wild beaſts there; but although the Bear has not, the conſtellations, under another name, have; for theſe two conſtellations were formed long before the name of two Bears was given to them, and even, in that time, they were both called by the ſame name, as we find from all antiquity.

We call them at this time the Waggons, as well as the Bears; and we ſhall find upon enquiry, that all our denominations of the conſtellations, and the terms which we uſe in expreſſing the ſeveral heavenly bodies, have an earlier origin than we might imagine. The Greeks were acquainted with theſe conſtellations before they called them by the names of Bears, or added to the hiſtory of the greater the fable of Caliſto. If we look into the oldeſt of their writings we ſhall find Amaxas, and not the word which ſignifies a bear, applied to them. Amaxas is the term by which they expreſs a wheel-carriage, a chariot, coach, or waggon. This was the earlieſt name of the two conſtellations: it was by this name they called them when they had firſt received the knowledge of them from the Egyptians, and it was moſt probable therefore, that this was a tranſlation of the Egyptian name.

If we were before convinced, that the Bears anſwered very well to the Cheſil, or Cheſilim, in their being of importance, and in their being two of the ſame name, we ſhall now find, that they agree alſo in the appropriation of the terms, *tying* and *looſing*, and bands or *cords*; for if we underſtand each of theſe conſtellations as the Greeks themſelves under this name deſigned it, as repreſented under the figure of a waggon, drawn by a team of horſes, we ſhall eaſily ſee, that looſing the bands was applicable to the harneſs of thoſe creatures, and that it might be eaſily uſed in a figurative ſenſe, in ſpeaking of the conſtellation.

Thus, inſtead of underſtanding by Cheſil, or Cheſilim, either Orion, or the Pleiades, we find, that there are two conſtellations in the heavens, which, in importance, quality, and figure, do perfectly agree with all that is ſaid in the different parts of the ſcripture of Cheſil and Cheſilim, and that no other but theſe two conſtellations can be made to agree with thoſe terms in which they are ſpoken of; theſe muſt therefore be they, and no other can be ſo. This is invalidating the tranſlation, but it is warrantable, and it is neceſſary. We ſhall find thus, inſtead of Orion and the Pleiades, Orion and the Great Bear, underſtood by Orion and Cheſil; and we ſhall find, inſtead of the indeterminate tranſlation of the conſtellations, the two Bears to be meant in the threatning of Iſaiah. It is indeed natural to ſuppoſe, that an aſſemblage of ſtars, ſo much reſpected, and ſo early in uſe as the Pleiades, ſhould be named in the ſcriptures, among thoſe which are ſpoken of, and we ſhall find it ſo. We ſhall find, that what is tranſlated in one of theſe paſſages, Arcturus, means the Pleiades. Who makes the Arcturus, Orion

Orion and the Pleiades, is in the original, who maketh Aish, Chimah and Chesil; and the true interpretation is, who maketh the Pleiades, Orion and the Bear; for by Aish the Chaldæans expressed the Pleiades, which they had formed into a constellation, notwithstanding that they were already a part of another constellation, and given to them the shape of a moth, the word Aish signifying a moth in that language. This is what our astrologers mean by the constellation Phalæna.

Pleiades is also a name given by the Greeks to a cluster of small stars in the neck of the constellation Taurus; they were supposed to shed a benign and kindly influence. *See* TAURUS.

POINT. Astronomy borrows this term from the mathematician, to express the place or spot from which, or to which a line, or surface, or any other degree, or species of quantity, is extended. It is customary to express the point by a small dot, made with a pen upon paper, but this does not properly convey the idea of the mathematician. He intends the point to have no extension at all, either in length, breadth, or thickness; but this dot, by which it is expressed, has both length and breadth, and it is therefore not a point, but a surface. It however is the only manner in which we can convey to the eye any idea of what is meant by the term, and to do this the most properly, is to make the dot the smallest possible.

The point is in reality an object of the understanding, not of the senses, and to understand properly what it is when we look upon the dot, made by the pen upon the paper, we are to take away every thing from it but place. Whatsoever is the object of the eye must be material, and whatsoever is material is divisible. Any thing therefore that can be the object of the sight, cannot express what is meant by mathematicians and astronomers by the point; since the latter take the term from the former, and they define a point to be without extension, without parts, and not divisible. This, though it cannot be expressed to the eye any more than a line, which, as it means length without breadth, cannot become an object of the senses, because in whatsoever form we would describe it, some breadth is necessary to render it visible; yet both this, and the line, may be conceived by the mind, as mathematicians define them: since we can, in the reflection, set aside that breadth, which, in order to render them visible, converts them into surfaces. Thus, if I conceive a strait line drawn from the centre of a piece of paper, each way to some distance, but not reaching to the verge of the paper, there is a place at which each end of the line stops. To describe it, I shall call these two places on the paper, the two points, which terminate the line, and, in this sense, I conceive them, and I use the term to express them exactly as the mathematicians mean. By the word point here, I only mean place, designed by an idea of fixture, but I do not cloath that idea with a visible form, because, if I did, I should give it extent, and it would then cease to be a point, becoming a superficies. It is with this term *point*, as with that of *line*, what is meant by it is not an object of the senses, or even of the imagination, for that would give them figure, and, as there can be no figure without breadth, would turn them both from their proper nature into surfaces; but they are objects of the understanding only, and they are formed by abstracting from the representation those parts which fall under the cognizance of the senses.

The relation of a point to a plane, *see under the article* PLANE.

POINT,

Point, *angular*. This is a term by which mathematicians expreſs that point, a t whic the two lines join, or touch one another, whoſe opening forms an angle. *See* Angle.

POLAR CIRCLES. Thoſe parallels, or parallel circles, which the ſtars ſeem to deſcribe about the pole in their diurnal revolution, which are at twenty-three degrees, and twenty-nine minutes diſtance from the pole. *See the article* Circles *of the Sphere*.

POLE, *its height*. The height, or, as it is often called, the elevation of the pole for any particular place, is eaſily to be taken by means of an inſtrument fixed in the plane of the meridian. It may be done by a ſingle obſervation either; the declination of the ſtar being known, and its diſtance from the pole added to its leaſt, or ſubſtracted from its greateſt height, the ſtar being in the arctic circle of the place; or by two obſervations, one of its greateſt, and the other of its leaſt height, the middle between which two is the elevation of the pole in that place. To decribe this more particularly:

If the latter method be choſen, and the height of the pole is to be determined by two obſervations, ſome ſtar is to be choſen for the obſervation, which is in the arctic circle of that place, and, conſequently, never ſets. This ſtar is to be obſerved in two points of its courſe, an inſtrument, for that purpoſe, being fixed in the plane of the meridian. One of theſe points is to be, when it comes to the meridian; the moment of this obſervation, which is known to be, when it comes with its centre acroſs the vertical hair, that is drawn over the eye-glaſs of the teleſcope, is the time when it is at its greateſt height; this height is to be marked down, and it is then to be watched at the place of its leaſt height, which is the loweſt point of its apparent motion, or, as it is truly called, with reſpect to theſe ſtars which are within the arctic circle, its oppoſite meridian: for, in reſpect of theſe, the whole parallel, in which they move, being above the horizon, the oppoſite meridian is to be ſeen, although, in reſpect to all others, it is hid behind the earth. This point of the oppoſite meridian is that of the leaſt height of the ſtar; its height here is alſo to be marked down, and this, and the greateſt being compared, the middle between them is the elevation of the pole in that place.

If the other method be preferred, the firſt thing to be done, after fixing upon a proper ſtar for the obſervation, the declination of that ſtar is to be known; this will be found in the tables of declination. When this is done, the ſtar being, as, in the former caſe, in the arctic circle of the place, only its greateſt, or only its leaſt elevation is to be known by obſervation; for taking from the greateſt height of this ſtar at the meridian, the meaſure of its diſtance from the pole, the remainder gives the elevation of the pole in that place. In this manner alſo, if the leaſt height of the ſtar be taken, all that is to be done is this, to add to it the diſtance of the ſtar from the pole, and this gives the elevation of the pole for that place.

When it was mentioned, that a proper ſtar was to be ſelected for this obſervation, the intent was, that a ſtar ſhould be ſelected, whoſe parallel did not, in any part, come very near to the verge of the arctic circle, for ſuch a ſtar being, in the loweſt part of its courſe, very near to the horizon, the obſervation would be liable to uncertainty and error from the refraction; for it is not only in the way of error from the refraction, but of uncertainty alſo, from the variableneſs of that refraction in general. In all the obſervations of the heavens

thoſe

thofe ftars are to be preferred which can be obferved at a great diftance from the horizon, and the nearer to the zenith the obfervations are made, the more they to be are depended upon, and it is nothing more neceffary than in thofe which are intended for this purpofe of giving the elevation of the pole.

The fame inftrument which ferved, on this occafion, is ready for taking the meridian of all the heavenly bodies, for being placed on the plane of the meridian, it is only obferving when any ftar comes fo before it, as to cut the vertical thread, and that ftar is then in its meridian.

POLES *of a Sphere.* The two points at which that diameter, round which a fphere turns when it has a rotatory motion on its own axis, terminate, or the two points at which that diameter of a fphere, which forms the axis on which it turns in that motion, terminate at the furface of the fphere. Thefe are the only points of the fphere which do not turn round when that motion is given to it. *See the article* SPHERE.

POLES *of the World.* Two points imagined to be placed in the heavens, and round about which the antients fuppofed the whole firmament made its revolution diurnally. The line continued from one of thefe to the other, was called the axis of the world, and was fuppofed to pafs through the centre of the earth, and to mark on its furface two points, called its poles, correfpondent to thofe in the heavens.

POLLICIS PROLES. A name given by fome of the old Latin writers to the planet Saturn. It not eafy to fay, why it was given to the deity of that name; but as we find by the oldeft accounts that it was, we need not wonder at its being transferred to the planet.

POLLUX. A name for a part of the conftellation Gemini. The Greeks pretended the two figures to reprefent Caftor and Pollux. *See the article* GEMINI.

POLYGON. A plane figure, which has many angles. This is the exact and literal fenfe of the word; but the aftronomers have followed the cuftom of the mathematicians, and limited it in fome degree. As they have exprefs names for all the plane figures, which have fewer than five angles, they fuppofe this name to belong only to thofe which have more than four, and thefe they diftinguifh under the general head of polygons, by feveral peculiar names, each expreffing the number of angles. The number of angles is always the fame with the number of fides, and, in confequence, when you have heard the name only of a polyon, you have a general idea of the whole figure.

The polygon which has five angles, for that is the loweft number, is called a pentagon, that with fix a hexagon, that with feven a heptagon, that with eight an octagon, and fo on. Polygons are divided, under thefe general heads, into two fpecies, under the names of regular and irregular. Thofe of the firft denomination have all their angles and fides equal, when thefe are unequal they are called irregular. When a polygon of any of thefe denominations is mentioned, it is always underftood to be a regular one, if nothing is faid to particularife the contrary.

Any polygon may be divided into triangles, and thefe of a determinate number, for they will be one for every fide; this is done by taking a certain fixed point any where within the polygon, and from this drawing a line to every angle. The confequence is plain, that as foon as this is done, each fide of the poly-

gon is become the base of a triangle, the legs of which are two of the lines so drawn, and the vertex, that point whence all the lines proceed; the use of this division is a very evident one, it is no other than a familiar manner of measuring the polygon; for according to the axiom, that the sum of all the parts is equal to the whole, the sum of the areas of all triangles is the sum of the whole area of the polygon. To measure these it is only necessary, that every triangle is the half of a parallellogram; and that all parallellograms, whether oblique angled ones, or rectangles, having equal bases, and equal perpendicular heights, are equal. There needs no more than to multiply the base of one of these, if they are equal, and if they are unequal, by the perpendicular height, the result of this gives the area of the parallellogram, of which that triangle is an half, and consequently half that sum is the area of the triangle; on such easy principles do the propositions in this science depend, and thus easily do they follow one another; thus easily is the area of any polygon found, by rules established on other occasions.

PORTA DEORUM, *the Gate of the Gods.* A name given by some, of the old fantastical writers on astronomy, to the constellation Capricon. The Pythagorean doctrine celebrated this constellation, as the place where the heavens were open, for the souls of good men to enter among the gods.

PORTA LUNÆ, *or* PORTA MANSIONUM LUNÆ. Names by which some have called the Milky Way; it is a name of eastern origin. What the old Chaldæans called the mansions of the moon, were certain spaces of the heavens, some of them marked with stars, and others without any, which the moon was observed to approach on the successive days of her revolution. There were twenty-eight of these mansions of the moon, the circle in which they were contained is that called Mazzaloth in the scriptures; and although the term Mazzaloth be a plural, in the manner of the Hebrew, it might very well be applied to a single thing, consisting of many distinct parts. Thus, to bring forth Mazzaloth in its season, is to bring forth every mansion, of which Mazzaloth was composed, in its season, As the whole circle of these chambers, or mansions of the moon, was called Mazzaloth; so the opening, or entrance into it, was supposed to be by the Milky Way, and that was afterwards called the gate of Mazzaloth, or the entrance of the mansions of the moon, Porta Mansionum Lunæ.

POTERIS. A name by which some, who are fond of uncommon terms, have called the Sun; it is originally an Egyptian name, and signifies the Holy Lord.

POWER. Astronomers express by the word power any number or quantity, when considered as capable, by muliplication, of producing, or being produced, by another quantity or number. When any quantity is multiplied by itself, the product is called a second power, this is the square of the number so multiplied. When this second power, or square, is multiplied by the first quantity, or simple power, the product is called the third power, or the cube. In all these cases, the simple quantity, or power, to which the rest owe their origin and production, is called, in numbers, the root; and, in geometry, the side of the square, or cube, for these are equal. Thus, in numbers, let the root be four, the square produced by four, multiplied by four,

is the ſecond power, this is ſixteen; and this multiplied again by the firſt power, produces the third power, or the cube of four, which is ſixty-four; and in lines, a line multiplied into itſelf produces a ſquare; here the line is the firſt power, and the ſquare the ſecond; and this ſquare, multiplied by the firſt line, generates the third power, or the cube. *See* SQUARE NUMBERS.

PRÆSEPE. A name given by the Greeks to a ſingle ſtar; a cloudy one in the breaſt of the conſtellation Cancer. *See its place in the account of the conſtellation.*

PRESTIS. A name by which ſome, who are fond of uncommon terms, have called the conſtellation Cetus. We find it called by this name among the old Greeks.

PRIMARY COLOURS. Thoſe colours which are formed by the ſeveral rays of light that are homogeneal, and conſiſt of particles, uniform in themſelves, but different between each other. The colours formed by theſe rays are red, orange, yellow, green, blue, and violet; theſe are primary colours; all the other colours are formed by different mixtures of two or more of theſe.

PROCELLA, *or* PROCELLA PELAGI. A name by which ſome of the old writers have called the conſtellation Capricorn, from an opinion of its being the occaſion of ſtorms.

PROCYON. A name by which the old aſtronomers have called the conſtellation over the neck of the Unicorn, more generally known by the name of the Little Dog. *See* CANIS MINOR. As they have ſometimes called the whole conſtellation the Great Dog, and ſometimes only the ſtar of the firſt magnitude, which is in its mouth, by the name Sirius; ſo they have ſometimes called the whole conſtellation of the Little Dog Procyon; and ſometimes they have underſtood by that name only the ſingle ſtar of the firſt, or, as ſome will have it, only of the ſecond magnitude, which is on the thigh of the right hinder leg in the conſtellation.

PROMETHEUS. A name familiar among the old Greek writers, as the denomination of one of the conſtellations; they mean by it that which is now called Hercules. The Greeks received their aſtronomy from Egypt; and, as they adapted their own fables to the figure of the conſtellations, which they had received from that people, they ſometimes changed their opinions about them. This conſtellation, which they received probably ſoon after the time of Thales, was meant, moſt likely, by the Egyptians, as an hieroglyphic; the ſenſe of which was, piety carries men up to heaven. Of this they had no notion, and they conſequently adapted, in different ages, different ſtories to it. Sometimes they called it Theſeus, ſometimes Orpheus, and ſometimes Thamyris; all this becauſe of the conſtellation Lyra juſt before it, an inſtrument for which they were ſeverally famous; ſometimes Ixion kneeling to deprecate the vengeance that attended his attempt on Juno; and ſometimes Prometheus faſtened on Caucaſus; but the moſt received opinion was that of its being Hercules fighting, or preparing to fight, with the Heſperian Dragon, which they repreſent by the conſtellation Draco ſeen juſt under his feet. The earlieſt of them gave no attention to any thing of this kind, but, naming things ſimply as they received them, they called this conſtellation Engonaſin, a man kneeling, and ſo we find it named in Ptolemy. *For an account of the ſituation and compoſition of the conſtellation, ſee* HERCULES.

P R

PROPORTIONAL QUANTITIES. Astronomers use this term to express certain quantities, or numbers, which have their ratio's to one another, and which are more in number than two.

There is frequent occasion to consider four quantities together, and to compare them by pairs. They are thus brought into the comparison, two and two; and when, under this consideration, it is found that the ratio between one pair, is equal to the ratio between the other pair, this equality of ratio, which they have reciprocally, pair to pair, is called proportion, and those quantities, which have it, are called proportional quantities, this term taking in all the four.

This proportion, between these several numbers, may be of two kinds. The first antecedent may be to the first consequent, as the second antecedent is to the second consequent, and, in that case, the proportion is said to be direct. For instance, if we produce the four numbers, four, six, eight, twelve, and compare them to this purpose, we shall find, that, dividing them into two pairs, 4 : 6 : : 8 : 12, the antecedent, in the first pair, bears the same ration to its consequent, as the antecedent, in the second pair, to its consequent, four being to six as eight is to twelve, two thirds of the quantity, and this is direct proportion. All this is expressed in their calculations, without the trouble of words, by the manner of noting the numbers down, which is, as I have expressed them in the figures, 4 : 6 : : 8 : 12, with these points between, express the ratio, and are understood to say, four is to six as eight is to twelve. Nor is this limited to numbers, for, if four lines are drawn proportioned to one another as these numbers, a first two thirds of the length of the second, and the third two thirds of the length of the fourth; and these lines are marked with letters for the sake of reference, the first with a. b. the second with A. B. the third with c. d. and the fourth with C. D. in writing them down by these letters, as the others are by the numbers, the proportion is conveyed to the reader. Thus, a b : AB : : c d : C D. The reader understands the computation without words, and knows, that, as a b : A B, so is c d : C D, the first therefore were proportional numbers, and these are proportional quantities. *See the article* RATIO.

It is usual to express quantities by numbers, and if this be done in direct proportion, more requires more, or less requires less; the greater the third number is, the greater must be the fourth, or, the less the third number, the less the fourth. This will be made familiar by an instance; if one degree of a great circle upon the earth be equal to sixty miles, to how many such miles will the whole circle, that is, to how many such will three hundred and sixty degrees be equal? Here more requires more, more degrees require more miles. The answer is found, by the common rules of arithmetic, to be twenty-one thousand and six hundred miles. To note this down, without the trouble of words, it is thus done, 1° : 60 miles : : 360° : 21600 miles. Thus is all this expressed in the compass of a quarter of a line, instead of spreading over half a page. But, to give an example on the other side, and shew how less requires less, let us suppose it asked, if the moon goes through a great circle in the heavens, or 360° in twenty-seven days, how many degrees does she go in one day? Here less requires less, that is, the less time of the motion will run through fewer degrees; the answer will be found to be thirteen degrees with a fraction as part of a degree, and it will be noted down thus, 27 days : 360° : : 1 day : $13\frac{9}{27}$. The golden rule answers

anſwers the queſtion in numbers proportional, three being given, this diſcovers a fourth.

When of three given quantities the firſt is in the ſame ratio to the ſecond, as the ſecond is to the third, the ſecond of the three is termed a mean proportional between the firſt and third; thus twelve is a mean proportional between ſix and twenty-four; and this alſo may be expreſſed in lines as well as numbers.

We have hitherto ſpoken of direct proportion only, or of that proportion in which more requires more, and leſs requires leſs; but there is another kind of proportion, in which more requires leſs, and leſs requires more. This is called reciprocal proportion; in this, the greater the third quantity is, the leſs will be the fourth, or, on the contrary, the leſs is the third, the greater will be the fourth. This is explained in the poiſing of unequal heavy bodies; if a moveable beam be placed upon a ſupport, and two weights, unequal in themſelves, are to be poiſed, or hung in equilibrio on the beam, that which is heavieſt muſt be placed neareſt to the ſupport of the beam, that which is lighteſt fartheſt from it, and this in an exact proportion to their weights, for the more is the weight, the leſs muſt be the diſtance, and the leſs the weight, the more the diſtance; this is reciprocal proportion. The ſupport here is the centre of gravity, and the diſtance being exactly proportioned, three of the numbers being given, a fourth is found by the golden rule inverſe.

PROPUS. A name by which the Greeks called a ſtar at the feet of Gemini mentioned with that conſtellation.

PROTOMES. A name by which thoſe, who love uncommon terms, call the conſtellation Equuleus, the Leſſer Horſe, or, more properly, the Horſe's head. It is part of a Greek name, by which Ptolemy has called it Hippou Protomes.

PROTRACTOR. The name of an inſtrument uſed by aſtronomers for meaſuring the quantity of an angle; it is a ſemicircle of braſs, or ſome other material, divided into degrees, and the angle to be meaſured is to be laid with its vertex at the central point of the inſtrument, and one of its legs a ſemidiameter of it, the other leg then falls upon the figures on the verge which marks the diſtance, or meaſure, the arc of the circle contained between them. It ſerves alſo for drawing angles of any quantity. The inſtrument will be deſcribed at large in the ſixth volume, or appendix to this work. *See alſo the term* ANGLE *in this volume.*

PROTRUGETES. A name given by the Greeks to a bright ſtar in the right wing of the conſtellation Virgo.

PTOLEMAIS. A name given by many to a ſtar in the extremity of the rudder of the conſtellation Argo; it is the conſpicuous ſtar that is uſually called Canopus, and had this name given to it in honour to Ptolemy Lagus, one of the Egyptian ſovereigns.

PTOLEMAIC SYSTEM. A ſyſtem of the univerſe, for the explanation of its ſeveral parts, and their relations to one another, as laid down by Ptolemy.

It was eaſy to perceive, that, of all the planets, the moon was that which was neareſt to the earth. This could not be unknown, becauſe every man ſaw, that, when ſhe came into the ſame line with any ſtar or planet, ſhe intercepted our view of them, or hid them; nay, that ſhe hid the very ſun itſelf from our ſight, as was the caſe in eclipſes of the ſun.

It

It was evident from this, that the moon was placed between us and them, and consequently that the moon was nearer to the earth than the sun, the fixed stars, or any of the planets.

Here was a first observation, which could not but be first, made, and which fixed the place of the moon, with regard to the earth, beyond a doubt; it was soon after perceived that the moon hid, or eclipsed, certain planets or stars, by coming before them when viewed from certain places at a certain hour, and that viewed from other remote places at the same hour, she was seen at a distance from those planets. They saw, that, from different parts of the earth, the moon did, at the same time, correspond to different parts of the heavens. When an age had gone thus far in observations, they found that there were natural and necessary consequences of the moon's being nearer to the earth than those planets; but not only this, they discovered that these differences would be great in proportion to that nearness; they saw them very great with regard to the moon, and very small with regard to the other planets; indeed they seemed almost, or altogether, insensible with regard to these while they were so very great with respect to the moon: they therefore perceived that the moon was not only nearer, but a vast deal nearer, to the earth than any of those. They observed farther, that her particular motion was very quick in comparison with that of any other of the heavenly bodies, and it was soon after determined, that the more slow the motion of any planet appeared, in comparison with that of the others, the more remote was that planet from the earth.

The place of the moon had been thus ascertained in these early times, and, after it, that of the rest of the planets. They placed Mercury next above the moon, because his motion was, next to that of the moon, quicker than that of any of the other planets. The earth was their immoveable point. They had thus placed the moon as making its revolution nearest to it, and Mercury as turning round it in a sphere behind, or somewhat farther distant than that of the moon. Next to Mercury they placed Venus, then the sun, and then, at farther distances, Mars, Jupiter, and Saturn. Each of these they placed in a particular sphere, which they called by its name, the sphere, or heaven, of Mercury, of Mars, of Saturn, and the rest.

As to the fixed stars, they soon found these to be very different from the planets; their motions being so extremely slow, in comparison of that of the planets, they placed them in a peculiar sphere, which they called the eighth heaven; this they supposed to be placed at a vast distance beyond the spheres of the most remote of the others; and they gave to this, and to all the others, a common motion which turned them all completely round the earth in the space of four and twenty hours. This, they said, was effected by what they called the *primum mobile*.

Those three planets, which they placed, in their system, beneath the sun, or between the sun and the earth, they called the inferior planets; these were the Moon, Mercury, and Venus; and the other three, which they placed above the sun, they called the superior planets; these were Mars, Jupiter, and Saturn. The revolution of the sun about the earth, in the same manner as that of the moon, was represented by excentric circles, which they said these planets formed by their motions round the earth; and these motions they distinguished by the name of *periodical motions*. With regard to the other planets, they represented theirs by means of an excentric circle, which they called *deferent*, on the circumference of which there was placed the centre of an epicycle,

cycle, which ran through this circle by a periodical motion, performed during the time that the planet was describing its epicycle, by a much swifter motion, in such manner, that the centre of the epicycle performed its revolution upon its excentric in the space of thirty years, that of Jupiter in twelve years, and that of Mars in about two years, while the planet, placed on its epicycle, ran over the circumference of that epicycle in one year.

It was in this manner that men at first explained the motions of the planets, and their different distances from the earth; and for this reason they seemed to go, at first, according to the course of the signs, with a very rapid motion, which, by degrees, grew slower and slower, till, at a certain time, it became scarce perceptible; and, after this, it became retrograde, or, they moved backwards; after which they became stationary again, or, for a certain time, seemed to have quite lost all motion; and, after this, continued their course in their first direction.

As to Mercury, and Venus, they were of opinion, that the centre of their epicycle was one line, which, being drawn from the centre of the earth, passed very near the centre of the sun; and that Mercury could depart to some distance on one side or the other of this, and Venus also to a larger distance, with regard to the earth. They allowed Mercury a distance of twenty-eight degrees, and Venus a distance of forty-eight.

They gave therefore to Mercury and to Venus an apparent periodical motion, which was very little different from the apparent motion of the sun, while those planets, however, made their revolutions about their epicycles, in a manner very different the one from the other.

To represent the different distances of the planets amongst one another, they supposed that the least distance of a superior planet exceeded, but very little, the greatest distance of its inferior; and having determined, with regard to each planet, the proportion of its least distance to its greatest, which was the result of a composition of its motions, they gave, to the orb of each, all the thickness, or depth, that this composition required.

Finally, in order to explain the inequality of the true, or apparent motion of the planets, Ptolemy supposed that the sun had an equal motion along the circumference of a circle excentric to the earth, and to this he had given an excentricity sufficient to represent all the apparent inequality of the motion found in his revolution.

With regard to all other planets he imagined, that the movement of the centre of the epicycle, round about the excentric, or deferent circle, was equal, and particularly that it was always slower in the apogee of the planet, and faster in the perigee; he reduced this to an equality, by reducing the movement of the centre of the epicycle to a point, taken in the line of its apogee, distant from the centre of the earth double the excentricity; for if he had placed the centre of the excentricity of the planet, as distant from the earth, as the centre of its mean motion, the variation of the bigness of the epicycles, seen from the earth, would have been evidently too large. Thus, the excentricity of their mean motion was divided into two halves by the centre of the excentric.

This is the system called the Ptolemaic, and attributed to Ptolemy for the inventor; it cost him pains, and it is not without ingenuity; but what is to be expected, when the principles on which men set out, are false? This would pretty regularly account for the appearances of the planets, provided one gives

to Mercury and Venus the same excentricity with the sun, and makes them move on epicycles, the centre of which is little distant from that of the sun: and if, with regard to the superior planets, we place them on epicycles, the semidiameters of which are equal to that of the distance between the sun and the earth: such was the account of things received for many ages. On what a different footing all things appeared when the first point was determined rightly, and the sun placed in the centre, will be seen under the article COPERNICAN SYSTEM.

PUGNANS. A name by which some of the Latin writers have called the constellation Hercules. They do not mean, by calling it a man fighting, to perpetuate the opinion of his combat with the Hesperian Dragon, but follow the system of those among the Greeks, who said it was Hercules, spent with toil, and covered with wounds, in his Ligurian conflict, after his arrows were all wasted, praying to Jupiter for stones to throw at his enemies. *See* HERCULES.

PUTEUS. A name by which some have called the constellation Ara, the Altar. We meet with it in some of the old Latin writers, and in some late ones, who love odd terms.

PYRAMME. A name by which we find the constellation Ara, the Altar, called in the writings of some who are fond of uncommon words; it is one of its old Greek names.

PYROIS. A name by which many of the old astronomical writers express the planet Mars. The word signifies fiery. Mars has a ruddy look in the skies, by which he is distinguished from all the other planets, and this being the most obvious of his characters, and conspicuous to all eyes, was the origin of his denomination in several languages. The names Azur and Azer, by which many call this planet, signify also fire.

Q.

QUADRATE. A name of one of the aſpects of the planets and conſtellations, under which, according to the old doctrines of aſtrology, they had a peculiar connexion, and a power of influencing ſublunary things. This is the Latin term for that aſpect, which we find mentioned under the name of Tetragonos among the Greeks; and it is that aſpect in which the planet and the conſtellation are at ninety degrees, or a quadrant of a circle, diſtant from one another.

The aſtrology and aſtronomy of the antients were blended, in ſuch a manner, together, that we muſt expect to hear of the one with the other, and to meet with the terms of the one in all the books that treat of the other. The aſpects were five in all: beſide this of the quadrate, or tetragone, there were the conjunction, the oppoſition, the ſextile, and the trine. In the firſt of theſe, the planet and conſtellation were together, and in the ſecond they were at half the circle diſtance, in the third they were at only ſixty degrees, and in the laſt at twice that, or one hundred and twenty degrees diſtant; in ſo few words is the whole doctrine of aſpects compriſed. In whichſoever of theſe relations the ſtar and the planet ſtood to one another, the antients ſuppoſed, that they ſhed a peculiar influence reciprocally from one to the other, or had, as they expreſſed it, mutual radiations, and co-operated together in the power that they exerted over human affairs; all this is jargon and nonſenſe; but it is a jargon that occurs ſo frequently, even in good writers among the antients, that it is neceſſary to be explained.

QUADRILATERAL FIGURE. A term uſed by geometricians, and from them borrowed by the aſtronomer, to expreſs any figure which has four ſides, be they equal or unequal. If the oppoſite ſides, or the oppoſite angles, are unequal, it is then a trapeſium. If a quadrilateral figure have its oppoſite ſides parallelled, it is then a parallellogram. If the parallellogram have all its ſides equal, and all its angles right ones, it is then called a ſquare. If a parallellogram have only its oppoſite ſides equal, and all its angles right ones, it is then a rectangled parallellogram; this the mathematicians ſometimes call ſimply a rectangle. If a parallellogram has all its angles oblique, and all its ſides equal, it is then called a rhombus. If all the angles of a parallellogram are oblique, and only the oppoſite ſides equal, it is then called a rhomboide.

Theſe are the principal kinds of parallellograms mentioned by the aſtronomical writers, and the method which is uſed to mark them by way of diſtinction, and for the more eaſy referring to their ſeveral parts, is by placing four diſtinct letters, or marks of any other kind, at the four corners. Sometimes it is

is mentioned only by two letters placed at the two oppoſite corners.

It will be often neceſſary, in aſtronomical calculations, to meaſure the quantity in the parallellograms. This canonly be donerationally, by conſidering what is the principle of the parallellogram, and in what manner it is generated, or formed; this will be eaſily underſtood from the courſe of the right line that begins it. A right line is firſt to be ſtruck of any given length, ſuppoſe, for inſtance, ſix inches; a ſecond right line is then to be ſtruck, which is to ſtand at right angles with the firſt: the firſt of theſe lines is called the dirigent, and the ſecond the deſcribent. When we have got thus far, in order to form the parallellogram, the ſecond right line, or deſcribent, muſt be carried, or moved, ſo as to be all the while parallel to itſelf in its firſt ſituation, along the dirigent. When the decribent has, in this manner, moved from its ſituation, which we will call the top of the figure to the bottom, and has then made a parallel line; the ſurface which it has, in that courſe, paſſed over, or deſcribed, is a parallellogram.

When we have thus regularly informed ourſelves of the generation and origin of the parallellogram, we ſhall very eaſily fall upon, and perfectly conceive the method of taking the quantities, or meaſuring ſquares and rectangles. I have given the length of the firſt right line, or the dirigent, at ſix inches, let us ſuppoſe the length of the deſcribent, or ſecond line, four inches. Let this deſcribent, before its motion, be divided into any number of equal parts, ſuppoſe four, and the dirigent, which ſpeaking of a rectangle, or ſquare, as the figure to be deſcribed, muſt ſtand, as already obſerved, at right angles with the other, into as many of the like parts as it contains; this, according to the proportion of the two given lines to one another, will be ſix. It is after this diviſion is figured, or marked out, upon the lines, that we are to begin the motion of the deſcribent, and this will perfectly explain the formation, and the menſuration of the figure at the ſame time. We now put the deſcribent into motion upon the dirigent. When it has moved one inch, let us ſtop, and we ſhall find the ſurface deſcribed by it to be four inches, that is, it will have moved the length of one of its diviſions,which being inches in this figure, the four will be contained in the figure in one row. When we have underſtood this, let us continue its motion one inch farther, it will then have taken in juſt four more, and the quantity thus taken in by the motion of a deſcribent of four inches upon a dirigent of ſix, will be eight ſquare inches; let us now continue its motions over double the ſpace of either of the laſt remains, it will then have deſcribed a line, equal to its own original length. The reſult of this is a figure, deſcribed by a deſcribent, upon as much of a dirigent as is equal to its own length, and the reſult is that figure which is called a ſquare: and the maeſure of this follows naturally from the knowledge of the length of the deſcribent, and the courſe of its motion, If in moving one inch it had deſcribed a ſurface of four inches, and in two inches of eight, it muſt, in the being carried four inches, have taken in a ſurface of four times four, that is of ſixteen ſquare inches; this is in reality what it has done; and the ſquare figure which we ſee thus, does indeed contain ſixteen ſquare inches.

But we are to remember, that the dirigent affords yet ſome farther ſpace, and the deſcribent may be moved along this: let us purſue its courſe, in order to underſtand the formation and quantity of parallellograms, that are more in their contents than ſquares. Thoſe ſeve-

ſeveral ſtages at which we ſtopped, of one inch, and of two inches, and that which we paſſed over of three inches, having deſcribed parallellograms, which were leſs in their contents than ſquares, we have ſeen the defect and the medium; let us conſider the exceſs.

From the reſting place of four inches, we will ſuppoſe we have moved down the deſcribent at once two more, that is, to the whole length of the dirigent, for it were multiplying words unneceſſarily to ſtop at five: when the deſcribent has moved the whole length of the dirigent, there is a rectangle deſcribed, which is half more than a ſquare, and its contents accordingly are not four times, but ſix times four, that is, twenty-four ſquare inches.

Whenſoever therefore we have a mind to meaſure a *rectangle*, or find the quantity of its area, the method is to meaſure two contiguous ſides of it, a top and a ſide, or a ſide and a bottom; we are to enquire what number of inches each ſide contains; when this is obtained, there is no more neceſſary than to multiply the one number by the other, or the number of inches on one ſide, by the number of inches in the other, and the product is the quantity or ſpace required. To inſtance in the given figure, ſix inches are contained in the dirigent, and four in the deſcribent of the laſt mentioned rectangle, ſix are to be multiplied by four, and the produce is twenty-four, which is the number of inches in the rectangle. If inſtead of this rectangle of unequal dimenſions, we were to have computed the quantity of that, which is every way of equal dimenſions, that is, the ſquare; all the ſides, being equal, the multiplying the inches in any one, by thoſe in any other, gives the quantity, in this a ſide being four inches, and a top, or bottom, four inches, four is to be multiplied by four, and the product is ſixteen, which is the number of ſquare inches in the area.

This method of expreſſing the quantity in the area of a figure is not limited to the ſquares and rectangles, of which we have hitherto been ſpeaking. The quantity of all plain figures whatſoever, as circles, triangles, and the like, is expreſſed in ſquare feet, ſquare inches, and other meaſures; nor is the computation limited to plane ſurfaces; but the convex and concave are meaſured in the ſame manner; but to explain the method of doing this would be foreign to the purpoſe here; what concerns aſtronomy will be perfectly underſtood by theſe familiar inſtances, the reſt belongs to the mathematics, &c.

When we enquire into the nature of that variety of parallellograms, which have been already deſcribed, we ſhall find, all ſuch as have equal baſes, and equal perpendicular heights, whether they be oblique angled, or rectangles, are equal. This is a propoſition of Euclid's, and the reſult is evident and important, it gives nothing leſs than the abſolute method of meaſuring, or finding the area of any oblique angled parallellogram; for it is plain from the propoſition, that if we multiply the baſe by the perpendicular height, the product is the area, or ſpace, contained. Thus it is in the propoſitions of this happy ſcience, they are all eaſy in their principles, and they all introduce one another.

When a ſtrait line is drawn from one corner of a parallellogram to the oppoſite corner, that line is called the diagonal of a parallellogram. If a line of this kind be drawn from the upper corner on the right, to the lower on the left, or from the oppoſites, it is equally a diagonal, and this diagonal divides the parallellogram into two equal halves, theſe halves are triangles, and theſe triangles are equal to one another. It is ſeen therefore by this, that every triangle

triangle is the half of a parallellogram, which has the same base, and the same perpendicular height. From hence comes a consequence of some importance. To find the triangle of an area, nothing more is necessary than to multiply the number of inches in the base by those in the perpendicular height; the consequence is evident from the propositions already laid down. The result of this multiplication is a product which gives the area of that parallellogram of which the triangle in question is one half, and the taking half the sum is the area of the triangle. It is thus that things, the most evident and familiar, introduce conclusions to the young student unexpected and important. Many of the propositions, laid down under this head, are so self-evident, that it seemed almost unnecessary to name them, but it is the way to have them remembered, and the most obvious of them has its use in the study, and will familiarize the person, who has not read the mathematics, to the conclusions in the several articles which concern the motions and magnitudes of the planets.

QUANTITY. The astronomer borrows this term from the mathematician, and expresses by it the subject on which mathematical reasoning is originally employed. He understands, by the term quantity, every thing which can be an object of enquiry as to degree, any thing in speaking, or thinking of which, men may enquire how great it is, or how much there is of it. Thus time and space came under the denomination of quantity, as also magnitude, weight, number, motion, and many other properties, adjuncts and affections, which we look on as belonging to material beings. All these are considered under the denomination of quantity, and thence become the objects of that part of astronomical disquisitions, which are built on the foundation of the mathematics.

Quantity is absolute, but the designation of that quantity varies, and one kind of it may, on many occasions, be described, or expressed by another, and this with great convenience and advantage. It is on this principle that numbers, which are one kind of quantity, and are, of all the kinds, most manageable and ready, will serve to express all other kinds of quantity whatsoever; and thus an infinite deal of labour and intricacy is saved in calculations. For a familiar example, if we have occasion to compare together the weight of two masses of meal, the weight of the one of which is just double to that of the other, it will be easy to express the weight of the greater by the number six, and that of the lesser by the number three; and thus the use of two little figures, which take up scarce any room, and are made without trouble, stands in the place of many words, and at the same time conveys the comparison more clearly.

This will serve to shew how the different quantities of heat, light, motion, and whatsoever else shall be needful to note down, may be expressed by correspondent numbers, a practice of endless use to the calculator, and the service of great ease and perspicuity.

Although numbers are thus happily calculated for expressing all kinds of quantity, yet it is not to numbers alone that the utility is confined. It will be explained hereafter how near a relation there is between lines and numbers in the doctrine of square numbers and their square roots; a side of a square answering, in all respects, to a root of the square number. On this occasion we may observe, that all kinds of quantity may be expressed by lines as well as by numbers. If it be necessary to describe a single day, I may do it by a line of a certain given length, the time of two days

will

will be then intelligibly expreſſed by a line of the ſame form twice as long, that of a week by one ſeven times ſo long, and ſo on. The form and diſpoſition of lines may be varied on this plan to ſuit all the variety of occaſions./ Thus different quantities may be expreſſed by ſquares, or rectangles of different magnitude. And in this manner we become able to compute any quantity, neceſſary to be known, two ſeveral ways, and by the aſſiſtance of two ſeveral arts. When this is done by figures, it is arithmetic that executes it; when by lines, rectangles, or ſquares, or the like, it is effected by geometry. Whether the quantities, under conſideration, be repreſented by numbers, lines, or ſquares, we may equally, with eaſe and certainty, compute by thoſe numbers, lines, or ſquares; and, by that computation, we ſhall learn the thing ſought, which is the proportions of theſe quantities to one another.

Quantities, of whatſoever kind, are conceived as conſiſting of different parts, theſe are ſuch as, being repeated a certain number of times, will produce the whole quantity, or elſe they are ſuch parts as cannot, by any repetition, produce the whole quantity. The former kind are called the *aliquant parts* of a quantity, and the others, or thoſe which cannot, by any repetition, be made to produce the whole quantity, are called its aliquant parts. This will be better explained in regard to numbers than to any other ſpecies of quantity. Three is an aliquant part of twelve, becauſe three, repeated a certain number of times, namely, four, will meaſure the whole quantity, or produces twelve, four times three being twelve; on the ſame principle, four, is alſo an aliquant part of twelve, becauſe, repeated three times, it meaſures the full quantity; on the contrary, five is an aliquant part of twelve, for being repeated twice, it produces a leſs number than twelve, namely, ten, and, being repeated three times, it produces a greater number than twelve, being fifteen. There being therefore no number of times under which five being repeated will produce twelve, five is not an aliquant part, but an aliquant part of the number twelve. In the ſame manner, a line of a foot long is an aliquot part of a yard, but a line, of eleven inches in length, will be an aliquant part of a yard, becauſe no number of times repeating it could make it meaſure the exact quantity of the yard.

Quantities *commenſurable*. This is a term uſed by aſtronomers in the ſame ſenſe with rational quantities; its purpoſe is to expreſs any two numbers or quantities, with regard to which a third number or quantity can be found, which is the common meaſure of them both. Thus the number two is a common meaſure to four and twelve, and three is a common number to nine and fifteen. Indeed when we ſpeak of numbers in the general ſenſe, they are, ſtrictly ſpeaking, all commenſurable, becauſe, being formed of units, an unit is a common meaſure to them all; ſuch, as ſpeak of certain numbers as incommenſurable, exclude the uſe of the unit; but this, though neceſſary to be explained, is making too free with terms in the uſe. As to quantities, all that are commenſurable may be expreſſed by numbers.

Quantities *incommenſurable*. Such quantities as have not any common meaſure; theſe cannot be expreſſed by numbers, as thoſe, which are commenſurable, may. For inſtance, the ſide of a ſquare, and the diagonal of the ſame ſquare, are incommenſurable quantities, for there is no meaſure common to both. Theſe are alſo called *ſurd quantities*.

Quantity *of an Angle*. Is the ſpace formed by

by the opening of two ſtrait lines which are joined in a point. This is not owing to, or determined by, the length of the legs, but only by the degree of their opening. *This is farther explained under the term* ANGLE.

QUIVER. One of the Arabian conſtellations; it ſtands in the place of the Grecian Sagitttary. The Arabians were forbidden, by their religion, to draw any human figure, ſo they give only the Quiver in the place of the Archer.

R.

R.

RADIUS *of a Circle, called alſo the Semidiameter of a Circle.* A ſtrait line drawn from any part of the circumference to the centre, and continued no farther. The word circle is a term borrowed by the aſtronomers from the mathematicians, and expreſſing any quantity of ſurface, that is of magnitude, extended in length and breadth, and circumſcribed within a figure, all parts of whoſe circumference are at an equal diſtance from its centre; this round figure is called a circle; it is formed by fixing one end of a line, and drawing the other round till it return to the point from whence it ſet out. In this, the point where the fixed end was placed, is the centre: and the curve deſcribed by its motion, is the circumference of that circle. If a ſtrait line be drawn any way through the centre, and terminated at each end at the circumference of this figure, this ſtrait line is a diameter of this circle; ever ſo many diameters may be drawn acroſs the ſame circle, the only requiſite to conſtitute them ſuch is, that they be ſtrait, and that they be drawn through the centre, and terminated by the circumference of the figure.

Any one of theſe diameters, or diametrical lines, divides the circle into two exact halves, and theſe are called ſemicircles.

If a ſtrait line be drawn from any part of the circumference to the centre, and do not paſs through it, but terminate, and ſtop there, it is called a ſemidiameter, or a radius of a circle.

The ſemidiameters of a circle are only ſo many repreſentations of the line, by the motion of which, round its fixed point, the circle was formed, ſtopping in that place; all ſemidiameters of the ſame circle are therefore equal; for in making of the circle, this line continued all the way of the ſame length, and conſequently theſe meaſures of it muſt be the ſame; the equality is not eſtabliſhed on a leſs certain foundation. If the circle have been drawn by a pair of compaſſes, for, in this caſe, the ſemidiameter is a line continued from the one point to the other of the compaſſes, and this muſt be of the ſame length, from whatſoever part of the circumference it be begun, becauſe the two feet, or points of the compaſs, have been kept at the ſame exact diſtance from one another, during the forming of that whole circumference, otherwiſe the circle would not be perfect.

Aſtronomers uſed the word circle in two ſenſes, which although related to one another, are not perfectly the ſame. They ſometimes expreſs by it the whole figure, including the continued curve, which makes the line about it, and the included ſpace, and this is the proper and ſtrict ſenſe of the term, for it means the complete figure; but they very often mean no more by the term circle, than the circumference of a circle; this, however, is leſs ſtrict and preciſe, and it were better, as there is a form of words to expreſs

exactly what they mean, that those words were used. When I say circle, I mean the whole figure; when I would express the curve line only, which marks the bounds of that figure, it were better to call it, as it is, the circumference of a circle; but this is not all, we meet with the term circle, used by authors, and those not inaccurate in other things, neither the term circle, used to express neither the whole figure, nor the line which circumscribes it, but only the space contained in it: but it were better to call this by its proper name; it is the area of a circle. The same confusion and inaccuracy will be observed in the same authors, speaking of the semicircle, but it is sufficient to have named it in this.

If there be occasion to mention any part of the circumference of a circle, separated from the rest, this is called an arc of a circle, or, as some write it less properly, an arch of a circle: this is the name for the piece of the circumference of a circle, be its quantity greater or less; and if they have occasion to mention a strait line, drawn from one end of an arc of a circle to the other, they call this the cord of the arc.

When a strait line is so drawn near a circle, as only to touch it in a point, that strait line is called a *tangent* of a circle. A tangent of a circle therefore is a strait line, which touches it in a point, and that in such a manner, that, if it were extended both ways from the point in which it touches, it would not enter into the circumference of the circle, nor cut any part of it; but, on the contrary, would, in its whole progress from the point of contact, be farther and farther off from the circumference. It will appear from this, that a radius of a circle, drawn to the point of contact, is perpendicular to the tangent.

As it is necessary, on many occasions, to speak of a circle, under several parts, or divisions, it has been found convenient to ascertain a certain general division, that men might, without the trouble of a new admeasurement, on every occasion, be able to speak intelligible to one another concerning those parts. To this purpose every circle is imagined to be divided into three hundred and sixty equal parts, and these have the name of degrees of a circle; so that when the term degree occurs, without any farther explanation, it is always known to mean a three hundred and sixtieth part of a circle.

As a farther division is also often necessary in speaking of smaller quantities, and with more precision, every one of these degrees, or three hundred and sixtieth parts of a circle, is, in the same manner, supposed to be divided into sixty equal parts, and these are called minutes. And as yet more accuracy may be required on other occasions, the division of these smaller parts is understood as carried on by sixty in the same manner. Thus, one of these minutes is supposed divided into sixty parts, which are called *seconds*, and every second, in the same manner, into sixty parts again, which are called thirds.

To save the trouble of unnecessary words, and quantity of writing, astronomers, in their calculations, express these several primary, and subordinate divisions of a circle, by certain marks: thus a degree is expressed by ($^\circ$), a minute by ($'$), a second by ($''$), and so on. If they have occasion, for instance, to express thirty-one degrees, five minutes, four seconds, they are not at the trouble of writing down those words at length, but they mark it thus, $31^\circ. 5'. 4''$.

RAH KASHKESHAN. A term which we meet with (in some of the astronomical writers, who will go very far for an hard word)

word) uſed as a name of the Via Lactea; it is the Perſian name of that part of the heavens, and its literal ſignification is the Road, or Way of Straw. As the Greeks gave the origin of this from milk ſpilt from the nipple of Juno; the Egyptians ſaid, it was a commemoration of the eſcape of their goddeſs Iſis from Typhon. In her flight before him they tell us, ſhe ſcattered burning ſtraw behind her, to impede his courſe, and that this was the origin of the name, and of the appearance in the heavens. As the Latins, and other Europeans, have followed the Greek tradition, and called this part of the heavens, the Via Lactea, or Milky Way; the people of the eaſt, in general, have followed the Egyptians, and called it the Way of Straw. Its names in the Coptic and Turkiſh, as well as the Perſian language, all ſignifying a way of ſtraw, as alſo the Tark Al Tibu of the Arabians: but theſe people have adopted both ſtories; for their other name, which is Tarik Al Lubanna, ſignifies the Way of Milk. This is no wonder; for the Arabs received their aſtronomy in general from the Greeks, as appears by the names of their conſtellations, being, in general, tranſlations of the Greek ones; but they alſo preſerved among them certain traditions, handed down from the Chaldæans. The one of their names therefore of this part of the heavens, was according to the Greek ſtory, and the other according to the Egyptian.

To form any idea of the mythology of the Egyptians, we muſt underſtand the nature of their country, as well as the turn of the inhabitants. We find, in all their early hiſtory, accounts of terrible land-floods, laying waſte every thing, and coming on ſo ſuddenly, that great numbers of people often periſhed in them. Theſe land-floods, ſo deſtructive to themſelves, and to their ſovereigns, whom they deified after their deaths, were charactered in their way of writing by hieroglyphics, under the name of the giant Typhon; and from this has ariſen all that part of the Greek fable which relates to the gods running away from Typhon, and his threatening them with deſtruction whenever he met them. Semiramis, who was, after her death, worſhipped under the name of Iſis, was, at one time, ſo near deſtruction by one of theſe ſudden innundations, that, in her flight, ſhe loſt a favourite ſon. This may be the flight of Iſis from Typhon, alluding to the ſtory of the Via Lactea, or, as they call it the Via Straminea, or Way of Straw; and the immediate origin of that fable may be this. We find it recorded, of the people of this country, that, whether out of ſuperſtition, by way of ſacrifice, or as an emblem of drying them up, they often ſet fire to whole foreſts of reſinous trees, through which the courſe of the country ſhewed, that the flood would, in a few hours, take its way. However this be, the name of Way of Straw, and Way of burning Straw, is univerſal in the eaſtern nations as a name of this part of the heavens.

RAI AL GIAUZA. A name given by the Arabs to the bright ſtar in the foot of Orion.

RAI, *or* Al Rai. A name by which ſome fanciful people call the bright ſtar in the foot of Cepheus. It is an Arabic name, and ſignifies the Shepherd; hence ſome call it Paſtor.

RAMPHASTES. A name by which we find ſome, who are fond of ſtrange words, calling the Toucan, one of the new-formed conſtellations of the ſouthern hemiſphere. The Toucan, under the figure of which theſe ſtars are arranged, is a ſtrange bird of American

rican origin, with a beak as large as its whole body. They have very wrongly called it the American goose, for it is not at all of the nature of that fowl. The earlier voyagers, who mentioned it, called it the Brasilian magpye, which was much more near to nature. It is described and figured in an history of animals lately published by the author of these observations. Its name Ramphastes is only a misspelling of Ramphastos, one of the denominations under which it is described by some of the best writers.

RAPHAEL, *or* St. Raphael. According to Schiller, and the enthusiasts his followers, a name of one of the constellations of the southern hemisphere. These writers set about what they called a reformation of the sphere, and their intent was to banish from the heavens all those figures which bore relation to pagan superstition, or pagan fables, and to put saints, angels, and apostles in their places. They had gone through the old constellations, placing one by one, new figures, in their room; a St. Peter for the Ram, a St. Andrew for the Bull, and Gideon's Fleece for the Hare at the feet of Orion. At length they came to the new-formed constellations of the southern hemisphere; and, to make short work of these, they take them, two or three, or more, together, into such as they put in their places. Thus, the Crane and the Phœnix made the high-priest Aaron, Job was formed out of the Indian and the Peacock, the Bird of Paradise the Chamelion, and the Fly-Fish went to make up the Eve of these innovators, and for this Raphael, the Dorado, the Toucan, the Hydrus, and the two Magellanic Nubeculæ. It is very well such innovations never took place among the generality of astronomers. It is necessary, for the sake of understanding the few books in which they occur, to explain them here; but, if they had ever been thoroughly received, the confusion in the study would have been endless, and we should have lost the advantage of all the early observations.

RATIO. It is necessary, on a multiplicity of occasions, to compare certain different quantities, or numbers, together, as to their degree, to know whether they are more or less one than the other, or whether they be equal; if they are unequal, and come under this consideration of more or less, when we consider by how much the one is greater, or is less, than the other, we are said to study the ratio of those quantities; and, when we are to put this down in words, the form of expression is, that the one is in such a ratio to the other. In these comparisons, we call the first quantity or number, antecedent, and the second is named the consequent. If, upon the enquiry, the two are found to be equal, the term ratio is still used; for the expression is, *that these two numbers, or these two quantities, have a ratio of equality*; if they are found to be unequal, the ratio is, that they have a ratio of inequality. When the antecedent is greater than the consequent, as, for instance, if the antecedent were twelve, and the consequent six, it is called a ratio of majority; if, on the contrary, the antecedent be less than the consequent, as, if the antecedent were six, and the consequent twelve, the term, to express this, is a ratio of minority. With regard to the ratio's of inequality, another distinction is also to be made as to the proportion which the lesser number bears to the greater. Suppose the numbers twelve and four, the lesser is then an aliquot part of the greater, because four, repeated a certain number of times, makes the whole sum of twelve; but, if the number were twelve and five, then the lesser number

is

is an aliquant part of the greater, becauſe five being repeated, whatſoever number of times, will not make twelve.

Aſtronomers have very frequent recourſe to theſe ratio's in their calculations, and they have found it convenient, for the ſake of expreſſing their ſenſe in a few words, to adopt certain terms expreſſive of the ſeveral principal kinds. When the ratio is a ratio of majority, and the antecedent is juſt twice equal to the conſequent, they ſay the antecedent is in a duple ratio to the conſequents; thus, ſix and three are a ratio of a majority called *a duple ratio*. When the firſt number contains the ſecond juſt three times, as, if the numbers are nine and three, it is then called a triple ratio; when four times, as twelve and three, it is a quadruple ratio, and ſo on.

When they are leſs regular to one another they yet have determinate names, as, if the antecedent contains the conſequent juſt once and and a half, as, if the numbers are three-two, it is called a ſeſquialterate ratio; if the antecedent contains the conſequent one and a third part, as, if the numbers are four-three, then it is called a ſeſquitertian ratio. This may ſerve to explain the terms uſed to expreſs the ratio's of majority. Thoſe of minority will be eaſily underſtood from theſe, for the terms that expreſs them are the ſame, only the prefix ſub is uſed to indicate the minority. Thus, if the antecedent number be contained twice in the conſequent, the term of the ratio is a ſubduple; when three times, it is called a ſub-triple ratio; when four times, as, in numbers three-twelve, the ratio is a ſub-quadruple; when once and an half, as two-three, it is called a ſub-ſeſquialterate ratio; when once and a third part, as three-four, it is called a ſub-ſeſquitertial ratio. Thus far we have conſidered two numbers only as the ſubjects of a ratio, but four may alſo be conſidered, comparing them by pairs. When this is the caſe, the equality, or ſimilitude of ratio's, is called by the name proportion, and the quantities are called proportional quantities. *See* PROPORTIONAL.

RATIO *of Powers*. The uſe of ratio's is not confined to ſimple quantities, it extends to their ſeveral powers in the ſame manner, but it is then expreſſed by peculiar terms. The ratio, between two ſecond powers, or ſquares, is called a duplicate ratio, and that between two third powers, or cubes, is called a triplicate ratio. In the ſame manner, the ratio, between a ſecond and a third power, that is, between a ſquare and a cube, is called a ſeſquiplicate ratio.

RATIONAL HORIZON. A term uſed by aſtronomers to expreſs that horizon which is formed by a circle, the plane of which paſſes through the centre of the earth. It is uſed by way of diſtinction from what is called the ſenſible horizon, which is a circle, the plane of which paſſes through that point of the earth's ſurface on which the obſerver ſtands. When aſtronomers ſpeak of the horizon in general terms, they are to be underſtood as meaning this rational horizon, for, if they intend the other, they ſpeak of it with the addition of the term ſenſible.

RATIONAL QUANTITIES. The ſame as commenſurable quantities, ſuch as may have a third quantity formed that will be a common meaſure to them both. *See* QUANTITIES.

RAVEN. One of the forty-eight old conſtellations. *See the article* CORVUS.

RAY *of Light*. The ſmalleſt part of light, which can be ſuppoſed to be acted upon, or

to act of itself, is, in that separated sense, called a ray of light. *See the article* LIGHT.

RAYS *of Light.* When any object whatsoever is before our sight, every point of that object, which is visible, sends forth from itself, as from a centre, rays of light in strait lines, through an hemisphere, every way equally. It is from this, that, in whatever part of the hemisphere a spectator stands, so that a strait line can be drawn from his eye to that point of the object, he sees that point. It is from this also, that the same point, or part of the object, is visible to many people, at the same time standing in different places. *See the article* LIGHT.

RAYS, *parallel.* All rays of light which can be drawn from any one point of an object, distant from a lens, to that surface of it which is toward the object, may be considered as physically parallel; for they are so near being parallel that they will be reflected, or refracted, as if they were parallel. From this it is evident, that the rays which come from the same point of an object, and fall upon the surface of a lens, turned directly toward the object, unite in a point beyond the lens. They will be so refracted at their passage out of air into glass, and out of glass into air, that they will be made to converge so as to meet somewhere at a point. The whole pencil of rays which thus coming from any point of an object fall upon the surface of the lens, turned directly toward the object, do meet accordingly in a point beyond the lens, and these rays thus comingfrom the point of the object, falling upon the surface of the lens, and uniting in a point behind it, are called a pencil of rays. A pencil of rays is therefore a double cone, the common base whereof is the section of the lens. The vertex of one cone is the radiating point of the object, the vertex of the other cone is the tip of the pencil, and a line drawn from one of these vertexes to the other, is the axis of the pencil of rays, and may be considered as a strait line.

The rays of light coming from different points of the same object cross each other in a vast many places, and this they do without at all hindering one anothers progress: this is owing to the inconceiveable smallness of the particles of matter which compose them, but still small as these particles are, it is amazing, that the rays do not, in some degree, impede one anothers passage.

RE-APPARENT STARS. Fixed stars which do not, like the others, keep their place and appearance at all times in the heavens, but are sometimes seen, and at others wholly invisible. The most remarkable of these is the famous new star in Cassiopeia, it appeared all at once, and gradually diminished in bigness and splendor, till it was quite lost again. *See* NEW STARS.

RECIPROCAL PROPORTION. That proportion between antecedents and consequents, in which more requires less, and less more, in opposition to the direct where it is contrary. *See* QUANTITIES PROPORTIONAL.

RECTANGLE. Astronomers use this term as more concise, for what they, at other times, call a rectangled parallellogram, either term expresses a quadrilateral figure, which has all its angles right ones, but in which only the opposite sides are equal to one another, this is what people vulgarly call a long square. *See* QUADRILATERAL FIGURE.

RECTILINEAR ANGLE. Expresses an angle

angle formed by two right lines which touch in a point. *See* ANGLE.

RED SEA. According to the ſyſtem of Schiller, one of the ſouthern conſtellations: he gives this name to the Eridanus of the old ſpheres, and deſires it may be underſtood that ſea over which the Iſraelites paſſed. Schickard will have it to be the brook Cedron.

REFRACTION. The bending of the rays of light, as they paſs out of one medium into another, in an oblique direction, the ſecond medium being of a degree of denſity, unequal to the firſt, is called refraction; this is different in degree, under different circumſtances, but is always ſtrictly conformable to its laws. If a line be drawn perpendicular to the ſurface of the ſecond medium, a ray going out of a thinner medium into a more denſe one, is refracted toward that perpendicular; but, on the contrary, if the ray go out of a denſe into a thinner medium, it is refracted from the perpendicular. This is the caſe if the ſurface of the ſecond medium be a plane.

When the ſurface of the ſecond medium is a curve, a line, which, being drawn to the point of contact, is perpendicular to the tangent of a curve, is perpendicular to that curve; a line, which, being drawn to the point of contact, makes oblique angles with the tangent, makes the like angles with the curve; in this caſe the mixt angle is equal to the rectilinear angle. It is on the principles of this propoſition that we are to explain the refraction in which the ſurface of the ſecond medium is a curve. The ray, paſſing out of one medium into another, the ſurface of that other being curve, is ſubject to the ſame general laws of refraction as when it is plane. If it falls perpendicularly upon the ſurface of the ſecond medium, it will continue to go on in a ſtrait line in the ſame direction as in the firſt medium; but, if it falls obliquely upon the ſurface of the ſecond medium, it will be refracted at the point of incidence, ſo as to bend towards the perpendicular, when the ſecond medium is more denſe than the firſt, and from the perpendicular when the ſecond is thinner than the firſt. Parallel rays, therefore, falling upon a lens turned directly towards them, the lens, then conſidered as a medium, will be refracted, ſo as to converge, or draw near to one another, and will at length meet in a point; at this point they will croſs one another, and from this point they will go on diverging, or ſpreading farther aſunder.

When a ray of light, in paſſing out of one medium into another of different denſity, falls inclined to the ſurface of the ſecond medium, it will not enter the ſurface of the ſecond medium, whether it be more denſe, or more rare, than the firſt, but it will be reflected in ſuch a manner that the angle of reflection ſhall be equal to the angle of incidence. If we examine this matter nicely, we ſhall find that all the rays of light are not equally refracted, or reflected, in paſſing through different mediums, for, with the ſame angle of incidence, ſome of the rays are more refracted, that is, are bent farther from the perpendicular, and others leſs; and when they fall very much inclined upon the ſurface of the ſecond medium, ſome of them are ſooner reflected than others, that is, with the ſame angle of incidence, ſome of the rays will be reflected, and others will not; theſe latter will require to have the angle of incidence ſtill leſs, in order to their being reflected. Thus, the light of the ſun conſiſts of rays different in themſelves, which is found by their being differently refrangible.

Light is not reflected, or refracted, by impinging upon the ſolid parts of the refracting, or reflecting, medium, but by a power which

is uniformly diffused through that medium, which acts upon the particles of light, without immediate contact, in a direction perpendicular to the surface of the medium. Light, in passing close by the sides of bodies, is bent out of its way, and that in such a manner, that parallel rays, passing on each side of any body, do converge, and, passing between two bodies, do diverge, whatsoever be the medium.

As one of the principal objects of astronomy is to fix the situation of the several heavenly bodies, it is necessary, as a first step toward any part of the science, to understand the causes which occasion a false appearance of the place of those objects, and make us suppose them, (for this is, in too great a degree, the case) in a different situation from that which they really have in the heavens.

In order to come at the bottom of this matter, we are first to consider that this earth, on which we live, and from which we make our observations, is every way surrounded with a gross, thick, and foul air, which we distinguish by the name of its atmosphere. This is the air we breathe, and this extends itself every way about the globe to a great distance; exactly how far it reaches we have not been able to determine. Above this, there is a much more pure and fine air, which we call æther. It is through this atmosphere that we see the stars, the rays from which bodies penetrating its substance, extend themselves to our eyes.

If these rays were directed strait from the stars to the centre of the earth, notwithstanding that they passed out of a rarer medium, the æther, into this more dense one, the atmosphere, they would continue their course in the same direction. But this is the case, in regard to us, only with those rays which fall directly from the zenith, or spot, over our heads.

Those rays, which come from the stars in the several other parts of the heavens to our eyes, traverse the atmosphere, in their way to us, in an oblique direction, and, in consequence of this direction, they do, in passing out of a more rare, into a more dense medium, bend, or alter their direction in some degree. This is the occasion that we see them out of their true situation, and they produce the same effect as we see when we view an object through water, through glass, or through any other medium which is more dense than air. If we thrust a stick obliquely into the water, it will appear broken at the place where it enters the water. If we view the bottom of a river it appears nearer to us than it is. Thus it is with whatsoever we view through a different medium, it appears in a place at some distance from that in which it truly is; and thus it is with the stars seen from the earth.

This action of the rays of light, which come from the stars to our eyes, and are thus bent in their course, is called astronomical refraction, and allowances are to be made for it in all observations. Thus, if we view a certain star, the rays coming from it to our eyes are bent at their passage out of the æther into our atmosphere, and consequently the eye sees them in a direction not truly their own; we know nothing of the star, or its place, but by these rays of light passing from it, and following the direction of these, thus altered, we see the star in a part of the heavens considerably higher than it really is.

There are two ways of determining these refractions, which we thus see are, and always must be, made. This may be done by immediate observations of the stars in their several degrees of height, or only by two observations at two different degrees of height, by the means of which we find the height of the matter which thus interrupts and diffects the rays,

rays, and the refraction which anſwers to all the other degrees of height up to the zenith.

The firſt method is the more natural, and it is that uſually employed for determining the refractions of the ſtars, when they are but a little way above the horizon; but we are obliged to have recourſe to the ſecond, when in the greater heights, where the difference of one degree from another is not enough ſenſible for being perceived in immediate obſervations.

The firſt method of determining refractions may be practiſed in any part of the earth, but the moſt exact, and the moſt ſimple operations of it are thoſe made under the equinoctial line, in obſerving the different heights of thoſe ſtars which are in the equator, or the height of the ſun at the time when he is in one of the equinoxes. There needs no more to this obſervation than to have an inſtrument ſufficiently exact for taking the heights of the ſun, or ſtars, and a well-regulated pendulum to meaſure the time that a ſtar, or that the ſun, takes in returning to the meridian from one day to another.

The perſon, who makes the obſervation, is to mark the hour at which the ſun, or ſtar, is arrived at different heights above the horizon, and, as the time, which the ſtar takes from day to day to return to its meridian, is to the interval between the hour of the obſervation and that of its paſſage through the meridian, ſo are three hundred and ſixty degrees to the diſtance of that ſtar from the zenith, the complement of which is the true height of the ſtar above the horizon. The difference, therefore, between this true height, and that which appeared in the obſervation, is the quantity of refraction anſwering to the height of the ſtar.

Thus eaſy and ſimple is the proceſs when the obſerver is placed under the equinoctial, but, when he is placed out of it, and the ſtar, which he is to view, has conſequently ſome declination, it is neceſſary to reduce into degrees, minutes, and ſeconds, as preſcribed above, the difference between the hour of the obſervation, and that of the paſſage of the ſtar through the meridian. Then, knowing the height of the pole at the place where the obſervation was made, and the declination of the ſtar, we have two ſides of a ſpherical triangle, the arc of which, meaſuring the diſtance from the pole to the zenith, gives the complement of the height of the pole at the place, and the other arc the complement of the declination of the ſtar, with regard to the equinoctial. The angle, compriſed between theſe two ſides, gives us the difference between the hour of the obſervation, and the paſſage of the ſtar through the meridian, in degrees, minutes, and ſeconds. We have the quantity of the third ſide, the true diſtance of the ſtar from the zenith, at the moment of the obſervation; and the complement of this is the true height of the ſtar above the horizon. The difference between this height, and that which appeared to be the height of the ſtar in the obſervation, meaſures the refraction; only that we are to obſerve, if the ſtar, which was the ſubject of the obſervation, have any parallax, that muſt be added.

The ſecond method of determining the quantity of this refraction is to determine, by obſervations, the refraction which anſwers to the two different degrees of height, and to have a ſurface elevated, at a certain diſtance above the earth, where the rays ſuffer refraction.

In all theſe obſervations the univerſal law of refraction holds, and the rays of the ſtars reaching our eye, are diſtorted in an equal degree, the angle of their refraction being always equal to the angle of incidence; and, in determining the quantity of this by the ſecond method, if the quantity be found too great or too little for that determined by the obſervation,

tion, it will be neceſſary to diminiſh, or to add, to the height, in proportion to that exceſs or diminution, till the proper quantity be found.

The height of the refraction being once eſtabliſhed, it is eaſy to find, in the ſame manner, the refraction which correſponds with all the degrees of height above the horizon, or of the apparent height of a ſtar above the horizon. And according to this hypotheſis, which repreſents, with a ſufficient exactneſs, thoſe refractions which have been determined by obſervation for the different heights of ſtars above the horizon, the ſubſtance, which cauſes thoſe refractions, appears to extend itſelf but a little way over our heads, in compariſon of the abſolute extent of the atmoſphere: for it is found, by repeated obſervations of this kind, that the height, to which it extends every way about the ſurface of the earth, is not more than four thouſand yards. This is very little in compariſon to the abſolute height of the atmoſphere; four thouſand yards is leſs than the height of many mountains, and the atmoſphere reaches to a height very much above that of the higheſt portions of the ſurface of the earth.

This obſervation gives birth to a conjecture, which, indeed, being rather matter of certainty than of ſuſpicion, deſerves a more poſitive name than conjecture. We know that the occaſion of this refraction is the entrance of thoſe rays which are ſubject to it out of a finer and more rare, into a coarſer and more denſe medium. We find that the place, where this refraction happens, is at about four thouſand yards from the ſurface of the earth, and that this is not the height of the atmoſphere, but only a certain height in it. It appears from hence, that what we call atmoſphere, is not, as might be ſuppoſed, one homogene, or ſimilar matter, but that in its upper part, or that above four thouſand yards, it is lighter and thinner, and is, in the reſt, thicker; above this mark it approaches to the nature of æther; below, it is thick. We ſeem to compute the whole maſs, from the given height to the ſurface of the earth, as all alike, and talk of the refraction it occaſions as ſingle; on the contrary, as it is here denſer than where it is more high, it probably grows more and more denſe from this height all the way to the ſurface, and, inſtead of the rays ſuffering one refraction, they ſuffer many. We ſeem to underſtand them as coming directly to our eyes from that height, but it is more probable that they are all that way paſſing from a more rare to a more and more denſe medium, and conſequently that they form a curve line following the tangent, whence we ſee the ſtar.

In order to determine the quantity of this curve, it would be neceſſary to know the exact degree of denſity of the atmoſphere at its different diſtances from the earth, but, as this is not known, it is ſufficient that we attend to the ſimple and eaſy method laid down here, by which it is eaſy to find the general quantity of refractions nearly, as well as by immediate obſervations; and to know, with great eaſe and tolerable exactneſs, by a ſtar's apparent height above the horizon, what is its real height.

The power of this refraction, in elevating the heavenly bodies to our view above their real places, is ſo great, that it is a known fact that we ſee the ſun before he is riſen and after he is ſet, at both times, while he is below the horizon; but this will appear the leſs ſtrange to thoſe unacquainted with theſe ſubjects, if they conſider, that, if they retreat ſo far from a baſon as juſt to loſe ſight of a piece of money laid in its bottom, the edge intercepting the view, they will ſee it, while ſtanding, in the ſame

ſame poſition, if the baſon be filled with water. The difference between the denſity of water, and that of the air, does this in this caſe, and the denſity of our atmoſphere, beyond that of the other, effects it in the other.

REGIO HEROUM. A ſtrange name by which ſome of the old writers have called the Galaxy, or Milky Way. It is impoſſible to underſtand the names theſe people gave to the ſeveral parts of the heavens without entering into their opinions. Thoſe among them, who called this lucid tract *circulus antiquus*, the old circle, or belt, underſtood it to have been once the part of the heavens through which the ſun took his courſe; and they tell you, that, when he turned away from ſeeing the banquet of Thyeſtes, he got into the zodiac, where he has remained ever ſince; in the ſame manner thoſe who call this part of the heavens Regio Heroum, the Region of the Heroes, founded it upon an opinion, that the ſouls of men being immortal, thoſe of the beſt and greateſt were taken up immediately after their deaths into the heavens, and allotted to a peculiar bright and happy place for their eternal habitation. This part they took to be the Milky Way, and ſome of them went ſo far as to explain its very ſplendor by the multitude of theſe bright ſpirits enjoying their exiſtence and freedom from the world and matter in it. This was one of the favourite doctrines of the antient ethnics, and we find it ſupported by the concurrence and adoption of a number of their moraliſts and beſt writers. Macrobius, in the Somnium Scipionis, refers to it in a very ſtrong and elegant manner in this light. The father, again repeating his admonition to his ſon, that he ſhould obſerve a true piety towards the gods, and deal juſtly with men, pointed out the immediate reward, and, directing his eye to the Galaxy, bade him there look upon the region which was the reward of virtue, and was, at that time, filled with the ſouls of great and good men, among whom he ſhould be admitted.

This opinion is of very early origin. Philo alludes to it, where he talks of the ſouls of the great and virtuous living in the higheſt heaven, and above the ſtars; he ſays their ſtation is in the moſt exalted part of the ſkies, and that they are the pure and unembodied ſouls of great men once on earth, whom the Greeks call, from their former ſtation, heroes; and Moſes, from their appointments, angels and miniſtering ſpirits.

REGULAR POLYGONS. Figures conſiſting of ſeveral ſides and ſeveral angles in any number more than four, the angles and ſides of which are all equal; if it be otherwiſe, they are called irregular. Figures of this denomination may be pentagons, hexagons, &c. *See* POLYGON.

REGULUS. A name by which aſtronomers have called a ſtar of the firſt magnitude in the breaſt of the Lion. They call it alſo Cor Leonis, the Lion's Heart. *See* LEO.

REPHAN. A name by which ſome, who are fond of uncommon words, have called the planet Saturn; it is one of the Egyptian names of that planet, and ſignifies, in their language, the god of time. We know in general, that the Greeks received the rudiments of their aſtronomy from the Egyptians, but we ſee, by ſuch inſtances as this, how cloſe they applied them. The god of time among the Egyptians, is the Saturn of the Greeks.

REVOLUTION. Aftronomers exprefs by this term a motion of two kinds; the one is, that motion which a body makes in going round fome other body; the other, that which it performs in turning round its own axis. The planets, and among them the earth, move round about the fun in orbits, or courfes differently remote from the fun; and the moon moves round about this earth, as do alfo the fatellites of Jupiter and Saturn, which are their moons round that planet; this motion is expreffed by the term revolution: and by way of diftinction, when the primary planets are fpoken of, it is called the annual revolution, the period of it being the year of each planet: but befide this, the earth, and thefe planets, and the moon, and their fatellites, do all the while they are in their feveral courfes turn alfo round upon their own axis. This motion is alfo called revolution, and when applied to the earth, is its diurnal revolution. The other, or greater revolution, is confined to the planets, and their fatellites; at leaft, thefe are all the bodies with which we are acquainted that are poffeffed of it; on the contrary, the leffer revolution, or that of bodies about their own axis, feems univerfal, and is fo far, as we know, impreffed upon all the heavenly bodies. If any thing could be fuppofed, exempt from it, we might naturally think the fun fhould be fo, but it is not. We diftinguifh, by the motion of his fpots, that the fun performs a revolution, about its own axis, in about twenty-feven days. The fixed ftars are too remote for us to fee the fpots, if there be any on their feveral phafes, by which alone we could determine whether they have fuch a revolution, and what is the period of it; but if we may judge by thofe called new ftars, which appear and difappear at certain times, and thofe very diftant from one another, we muft conclude, that the appearance of thefe ftars is owing to the turning of a luminous fide toward us, and their difappearance to the withdrawing that, and turning an obfcure one; if this be the cafe, it muft be owing to a revolution of thofe ftars about their axis, and as thefe are undoubtedly fixed ftars, we are to judge from them of the others, and to fuppofe, that the fixed ftars have a revolution round their axis, and that it is not performed otherwife than in a very long period of time.

That the planets, in general, revolve about their axis, we have demonftration, the moon herfelf, notwithftanding her appearance of being unmoved, in this refpect, not excepted. It has been indeed doubted, with regard to Saturn, but this is only becaufe that planet is at fuch a diftance, that we cannot fee his feveral phafes on which that revolution could be proved; as to the reft, it is evident, the primary planets make their general revolutions, or, as they may be called, their annual revolutions, round the fun in the following periods, proportioned to their diftances, and their feveral magnitudes. Mercury being of two thound fix hundred miles in diameter, and at thirty-two millions of miles diftance from the fun, performs his revolution round the fun in eighty-feven days, twenty-three hours, and fixteen minutes; this fhort period therefore is the year of Mercury. Venus being feven thoufand nine hundred miles in diameter, and diftant from the fun fifty-nine millions of miles, performs her revolution round the fun in two hundred and twenty-four days, fixteen hours, and forty-nine minutes. The earth being in its diameter feven thoufand nine hundred and thirty-five miles, and diftant from the fun eighty-two millions of miles, performs her annual revolution in three hundred and fixty-five days, fix hours, and nine minutes. Mars being four thoufand eight hundred miles

in diameter, and at the diſtance of one hundred and twenty-five millions of miles from the ſun, performs his revolution in ſix hundred and eighty-ſix days, twenty-three hours, and twenty-ſeven minutes. Jupiter being ſeventy-ſeven thouſand miles in diameter, and at the diſtance of four hundred and twenty-ſix millions of miles from the ſun, is in performing his revolution four thouſand three hundred and thirty-two days, twelve hours, and twenty minutes; and Saturn being ſixty-ſeven thouſand miles in diameter, and ſeven hundred and eighty millions of miles diſtant from the ſun, is ten thouſand ſeven hundred and fifty-nine days, ſix hours, and thirty-ſix minutes in performing his revolution, ſo long are the years of Jupiter and of Saturn.

While the planets are thus performing their revolutions round the ſun, they are all the time alſo performing their leſſer revolution, or that which is round their own axis. That of Saturn cannot be aſcertained, becauſe we cannot even be aſſured there is any ſuch, otherwiſe than from reaſon and analogy. That of Jupiter is performed in nine hours, fifty-five minutes, and is the quickeſt known motion in all the heavens. That of Mars is performed in twenty-four hours, and about forty minutes; that of the earth we know to be in twenty-four hours; that of Venus has been ſtrenuouſly aſſerted by Bianchini, and ſome others, to take up twenty-four days; but it is, in reality, performed in a little more than three and twenty hours; and as to Mercury, he is as much too near to the ſun, as Saturn is too remote from the earth, to give opportunity for the determination. The ſeveral phaſes of Saturn we cannot ſee, becauſe of his great diſtance; and in Mercury we can no more ſee them, by reaſon of his being always ſo near the horizon, that the vapours of our atmoſphere prevent a diſtinct view of him.

Thus we ſee the day of Jupiter is not quite ten hours, although his year be of the length of twelve of our years. The year of Mars is near two of our years in length, and yet his day is but very little longer than our day. The year of Venus is but little more than half our year, and yet her day is nearly the ſame with ours. Of the day of Mercury we know nothing, but his year is about a quarter of ours.

While the primary planets are thus performing their greater revolutions round the earth, and, at the ſame time, their leſſer revolutions about one another, their ſeveral ſatellites are alſo performing their great revolutions about them, and, as they go, their ſeveral leſſer revolutions about their own axis, although we can diſcover, that they have this leſſer revolution, we cannot tell the time of it, for they are too remote for ſuch obſervations as could alone accompliſh it; but the periods of their ſeveral greater revolutions have been determined, as well as their diſtances from the planets, or diameters of their ſeveral orbits. As to thoſe of Jupiter, the diameter of the orbit of his firſt ſatellite, or that neareſt to his body, is three minutes, and fifty-five ſeconds, and its revolution is performed in one day, eighteen hours, twenty-eight minutes, and thirty-ſix ſeconds. The ſecond ſatellite has for the diameter of its orbit ſix minutes, and fourteen ſeconds, and the period of its revolution is three days, thirteen hours, ſeventeen minutes, and fifty-four ſeconds. The diameter of the orbit of the third ſatellite is nine minutes, and fifty-eight ſeconds, and the period of its revolution is ſeven days, three hours, fifty-nine minutes, and thirty-ſix ſeconds. The diameter of the orbit of the fourth ſatellite of Jupiter is ſeventeen minutes, and thirty ſeconds, and it performs its revolu- about that planet in ſixteen days, eighteen hours, five minutes, and ſeven ſeconds.

As to the ſatellites of Saturn, their revolutions are alſo proportioned to their diſtances, and are as follow. The diameter of the orbit of the firſt ſatellite is one minute, and twenty-ſeconds, and the revolution of that ſatellite about the body of the planet is performed in one day, twenty-one hours, eighteen minutes, and twenty-ſeven ſeconds. The diameter of the orbit of the ſecond ſatellite is one minute, fifty-two ſeconds, and the period of its revolution is two days, ſeventeen hours, forty-four minutes, and twenty-two ſeconds. The diameter of the orbit of the third ſatellite is two minutes, and thirty-ſix ſeconds, and the time of its revolution is four days, twelve hours, twenty-five minutes, and twelve ſeconds. The diameter of the orbit of the fourth is ſix minutes, and the period of its revolution is fifteen days, twenty-two hours, thirty-four minutes, and thirty-eight ſeconds. And the diameter of the orbit of the fifth, or moſt diſtant of all the ſatellites of Saturn, is ſeventeen minutes, and twenty-five ſeconds, and the periods of its revolution is ſeventy-nine days, ſeven hours, and forty-ſeven minutes.

RIGHT *Part of Heaven.* Different people mean very different parts of the ſkies by this term. With the geographer it is the eaſt, and with the aſtronomer it is the weſtern part, with the prieſt, or augur, it is ſouth, and with the poet it is the north; all this is owing to the way they ſuppoſe people to turn their faces when they ſpeak; the geographer always looking to the north, the aſtronomer to the ſouth, the augur to the eaſt, and the poet to the weſt.

RIGHT SPHERE. If the earth divided, according to the aſtronomical manner, by circles, were to be viewed from a great diſtance, the eye being placed in the plane of the equator extended, the equator would not ſhew itſelf as a circle, nor part of a circle, but as a ſtrait line drawn over the globe's ſurface, and touching it only in a point; and, in the ſame manner, the parallels to the equator would appear as ſo many ſtrait lines, not circles, and the conſequence would be the ſame, that they would ſeem to touch the earth only in a point, and not to go round it: for their poſition making them appear ſtrait lines, and the reaſon keeping up the remembrance of the earth's being a globe, it would appear, that lines could not touch a ſphere in more than a point, and thus they would appear to do. It is eaſy to ſee that only a ſemicircle of each of theſe circles would be ſeen; but thoſe who are acquainted with perſpective know, that if the whole circles could be ſeen, that is, if the ſolid body of the earth were removed, ſtill the equator would be only a ſtrait line, for a circle viewed from a diſtance with the eye, in the plane of that circle, appears but as a ſtrait line: it is therefore only an half of the equator, and an half of each of the parallels, that would be thus ſeen by an eye, placed at an infinite diſtance, and in the plane of the equator, and theſe halves of circles would repreſent ſo many right lines. The ſphere of the earth, therefore, as ſeen by an eye, in ſuch a ſituation, would be called a right ſphere, but the term may be brought nearer to the point, for it is not in idea that the right ſphere is to be underſtood. Whatſoever would be the caſe to an eye, placed at a diſtance in the plane of the equator, is, in ſome degree, the caſe of thoſe who live on the equator, or, as it is called, under the line. Theſe are ſaid to live in a right ſphere; for being at an exactly equal diſtance from both the poles, they have both of them in their horizon, and they have a right horizon, becauſe the celeſtial equator, and all the north and ſouth

fouth parallels, cut their horizon atright angles, this is what is meant by the terms right fphere, and right horizon, and they can happen to none except thofe who live under the line.

What is intended by the two other terms, oblique fphere and parallel fphere, will eafily appear from this. Whatfoever part of the earth a man lives in, provided it be between the equator and the poles, he will have the celeftial equator interfecting his horizon obliquely, and he is therefore faid to live in an oblique fphere; and, in the fame manner, whofoever lives at the poles, has the equator parallel to his horizon, one of the poles of the heavens being always in his zenith, and the other in his nadir, and thefe being the poles of the equator, the horizon is to fuch a perfon a parallel, or a regular circle diftant equally in all its parts from the equator, and from the pole, and fuch a perfon is faid to live in a parallel fphere. This will explain what neceffarily relates to the fituation of the right, parallel, and oblique fphere.

RIPHEAN CLIMATE, *or Climate of the Riphean Mountains, (for that is the proper term at length.)* A name given by the antients to their feventh and laft climate, north of the equator. They had not our way of dividing by the degrees and minutes of latitude, and they divided the furface of the globe fo far as it was known to them into climates, they began thefe at fome diftance from the equator. The firft parallel they took notice of, or that which made the beginning of their firft climate, was when the longeft day was twelve hours and three quarters, for all between that and the line, they fuppofed either as a right fphere, and fo fubject to nothing of the obliquity which gave origin to their climates, or elfe difregarded it as uninhabitable by reafon of the heat; from this they began the divifion, and every parallel which was at fuch a diftance, that the longeft day differed at it half an hour from the length of that, at the laft was the limit of a climate.

Thus each climate comprifed fo much of the furface of the globe as fell between two parallels, at which the length of the longeft day differed but four hours, and they divided each of thefe into two portions, but thefe not exactly equal in fpace, for that toward the equator, for obvious reafons, was always the larger, by another parallel, at which the length of the day was a quarter of an hour more than at one of the extreme parallels, and a quarter of an hour lefs than at the other; this middle parallel marked the middle of the climate, and the reft of it they reckoned it under the terms of the beginning, or the end of it. Under this parallel, in the middle, they found fome confiderable place, and from this they named that climate. Thus they diftributed what they knew of the globe north of the equator (for fouth of it they knew nothing) into thefe feven climates, and the firft of them from Meroe being in the middle of it, they called the climate of Meroe, the fecond, for the like reafon, they called the climate of Syrne, the third the climate of Alexandria, the fourth the climate of Rhodes, the fifth was the climate of Rome, or, as fome others called it, of the Hellefpont, and the fixth of the Boryfthenes; this of the Riphean mountains was the feventh.

RIVER. A name for the conftellation, now diftinguifhed from the Jordan and Tigris by the name Eridanus.

RHODES, *Climate of.* The climate of Rhodes was, according to the old divifion, the fourth of the climates, north of the equator. Thefe climates were an eafy invention

to

to ſerve in the place of our diviſion, by degrees, and minutes of latitude. The antients divided ſo much of the ſurface of the globe, as was known to them, into what they called ſeven climates, beginning at ſome diſtance from the line, where all was unknown, and ſuppoſed uninhabitable: each climate was contained between two parallels, at one of which the longeſt day was half an hour longer than it was at the other, theſe were called the beginning and the end of the climate; and that parallel, in which the longeſt day was a quarter of an hour longer than at the one, and a quarter of an hour ſhorter than at the other, was called the middle of the climate. They named each climate from ſome conſiderable place that lay under this middle parallel; and the city of Rhodes being ſuppoſed to occupy this ſituation with reſpect to the fourth climate, that was called the climate of Rhodes.

RHOMBOIDE. A quadrilateral figure, or parallellogram, which has all its angles oblique, and in which only the oppoſite ſides are equal. *See* QUADRILATERAL FIGURE.

RHOMBUS. A quadrilateral figure, which has all its angles oblique, and all its ſides equal. *See this farther explained under the article* QUADRILATERAL FIGURE.

ROAH. A name by which ſome, who are fond of uſing uncommon words, call the conſtellation Auriga; it is a part of the Hebrew name of that conſtellation, the whole is Ha Roah Schohide Ha Reſan, and the ſenſe of it is the ſhepherd holding a bridle; and, in the ſame manner, the Arabs call it Maſik Al Inan, one holding a bridle.

ROBUR CAROLINUM, *the Royal Oak, or King Charles's Oak*; *or, not to omit ſo notable a name, the* Carolina Oak, *as one of the Engliſh aſtronomers calls it*. One of the conſtellations of the ſouthern hemiſphere. This is not one of the old forty-eight, but has been ſince deviſed by the modern aſtronomers to take in ſome of the unformed ſtars of that hemiſphere.

The Royal Oak is not a very large conſtellation, nor, in proportion to the ſpace which it occupies in the heavens, does it comprehend many ſtars. Thoſe which are accounted to it are however ſo well placed, and many of them ſo conſpicuous, that it is eaſily diſtinguiſhed and aſcertained in the heavens. The conſtellations between and among which the Royal Oak is placed, are the Chamelion, the Centaur, the Ship, and the Flying Fiſh. The Chamelion is placed near its root, and is on its back; the curled part of the tail of this conſtellation nearly reaches to the bottom of the trunk. The hinder legs and tail of the Centaur are very near the top, or the tufted part of the tree; the Ship is cloſe to it on the oppoſite ſide, and the Flying Fiſh is near its trunk, on the ſide oppoſite to that on which the Chamelion is; and this creature is in a direction nearly parallel to that of its trunk.

The figure under which this conſtellation is repreſented in the heavens is that of an old oak-tree, with a thick trunk, and a top not very much branched. The ſtars in the Royal Oak are twelve, and ſome of them are large enough to be ſufficiently conſpicuous; there are two in the trunk, one toward the root, and one toward the top, where it begins to divide into branches; there is a cluſter of four juſt where the branches begin, at the lower branch, on one ſide there are two, on the top of the other branch there are alſo two, and there are two other ſmaller about the branches, on the lower part on this ſide.

The

The figure, underſtood by this conſtellation, is that of the oak in which King Charles II. was, while his enemies were in purſuit of him; and this the modern aſtronomers have raiſed up into the heavens, as the early authors, in the ſame ſtudy, did the Scorpion that killed Orion, or the monſter that was to have devoured the unfortunate Andromeda.

ROME, *Climate of*. A name of the fifth climate north of the equator, according to the diviſion of the antients. The way of marking down the diſtance of places in degrees and minutes of latitude being not then known, they had recourſe to a diviſion by climates. They divided ſo much of the ſurface of the globe, as was then known to them, by this means, into what they called ſeven climates north of the equator, for the countries to the ſouth they were unacquainted with. Each climate compriſed ſo much of the ſurface of the globe as lay between two parallels, ſo diſtant from one another, that the longeſt day at the one was half an hour different from the longeſt day at the other. They uſed to name each of theſe climates by the name of ſome conſiderable place that was in or near the middle of it; they thus called their fifth climate, in the middle, or about the middle of which they ſuppoſed Rome to be, the climate of Rome; though this was not univerſal, for we find this fifth climate called alſo by ſome the climate of the Helleſpont. The ſixth was that of the Boryſthenes.

ROSE, *myſtic*. A name given, by Schiller and his followers, to the conſtellation Equuleus.

ROTA, *and* Rota Ixionis. A name by which ſome, who are fond of uncommon words, have called the conſtellation Corona Auſtralis, or the Southern Crown. They have ſuppoſed it Ixion's wheel, and Mercury's Caduceus, and a garland, and have called it by ſo many different names at different times, that it ſeems as if they had not any very ſettled form of drawing the figure. We ſee it in that of a crown in the northern ſchemes of the heavens, but poſſibly that was not always its figure.

ROTATION. A term properly applied to the earth, to expreſs that motion which it performs in its revolution about its own axis; but, as an apparent conſequence of this is, that the ſphere of the heavens appears to to have a motion in a contrary direction round it, ſome have uſed the term to expreſs the appearance, and not the reality, and have talked of a rotation of the heavens. Thus, as it is the earth, on which we live, that moves, muſt appear an univerſal motion with reſpect to all parts of the heavens, excepting only thoſe two fixed points correſponding to the earth's two poles, and called the poles of the heavens. Theſe appear to keep their places, and as the places of all the ſtars are in parallels between one and the other pole, and the equator, and theſe parallels are of the nature of thoſe of the earth, circles becoming ſmaller and ſmaller toward the poles, and larger and larger toward the equator, the motion of the earth being, from weſt to eaſt, the apparent motion of the heavens, which is owing to it, will be in a contrary direction, that is, from eaſt to weſt: and thus thoſe ſtars, which are in the equator, will appear to round the earth in the celeſtial equator, or directly over the earth's equator, and thoſe, which are at a diſtance, greater or leſſer from it, will appear to go round the earth in a parallel, or a circle drawn parallel to the equator, and paſſing through the point in which is the place

of

of that ſtar. This circle, by the motion above-mentioned, will be greater the nearer the ſtar's place is to the equator, and leſſer in proportion as it is nearer to either of the poles; all paſſing over certain parallels to be conceived upon the earth, as thoſe in the equator of the heavens paſs over the equator of the earth. Theſe parallels in the heavens, in which the ſtars perform their apparent rotation, and thoſe on the earth, which are anſwering to them, are called correſpondent parallels.

ROYAL OAK, *Robur Carolinum.* One of the conſtellations of the ſouthern hemiſphere, and of the number of thoſe that have been formed by modern aſtronomers. Some of the forty-eight conſtellations were in this hemiſphere, as the Piſcis Auſtralis, the Argo, and the like; but this is of later date. *For an account of its ſtars, ſee* ROBUR CAROLINUM.

RUCHA. A name by which ſome, who are fond of uncommon words, have called the conſtellation Urſa Minor, or the Leſſer Bear; it is one of its Arabic names.

RULXBAHIC. A ſtrange name by which ſome have called the conſtellation Hercules; it is a word of no language in the world, but ſeems to have ariſen from a falſe writing of the Giathi Ala Ruchbatichi, which is an Arabic name of this conſtellation.

S.

S.

SACLATENI. A name by which ſome have called the bright ſtars in the arm of Auriga, which the antients called Hœdi, and the Kids. This is an Arabic name given to them.

SACRARIUM. A name by which ſome, who are fond of uncommon words, have called the conſtellation Ara, the Altar; it is one of its old Latin names.

SADATENI. A name given by the Arabs to two bright ſtars in the arm of Auriga. Some of the late writers, who are fond of hard words, have borrowed the name.

SAD'R, *or, as it is ſometimes written,* SADIR. A name of a ſingle ſtar in the conſtellation Caſſiopeia; it is the bright one on the breaſt that is called by this name, and the word is Arabic, and ſignifies the breaſt. They had a cuſtom of naming ſingle ſtars thus from their places.

SAGITTA. One of the conſtellations of the northern hemiſphere, and a very conſpicuous, although a very ſmall, one; it is one of the forty-eight old conſtellations, or thoſe which the Greeks have received from the Egyptians, and which are mentioned by all their writers. It contains but few ſtars in compariſon of many of the others, but then it is alſo of very ſmall extent in compariſon of thoſe: with reſpect to the ſpace it occupies in the heavens, it is not behind them in number of ſtars.

The Sagitta is repreſented, in all the ſchemes of the heavens, in figure of an arrow, ſuch as the antients uſed in war, and ſuch as we find deſcribed by their authors; it is ſtrait and ſlender, bearded at the point, and feathered at the other end; at its middle, there is a ſquare, which takes in, very luckily, ſeveral ſtars.

The conſtellations about the Arrow are the Eagle, the Dolphin, and the Fox and Gooſe. There is a ſpace formed between theſe three, in the upper part of which this little conſtellation is placed; the Fox and Gooſe is immediately over it, and very near; the point of the Arrow coming very near to the right fore leg of the Fox; the Eagle is under it at a ſomewhat greater diſtance; the Arrow is placed ſlanting, but the feathered end comes toward the tail of that bird; the Dolphin is on one ſide of it, tolerably near, and on the other Hercules, but at a great diſtance.

The antients counted five ſtars in Sagitta. Hipparchus, who made the firſt catalogue of the fixed ſtars that is known of, ſet down ſo many in it; Ptolemy followed his account; Tycho continued the number five; Hevelius the ſame, ſo that, till the obſervations of Flamſtead, the conſtellation ſtood, in this reſpect, as it had been eſtabliſhed by thoſe who firſt

took account of it, but Flamstead counted no leſs than eighteen in it. Theſe are diſpoſed pretty regularly over the figure; there is one unformed ſtar, but accounted to the conſtellation, ſtrait before the point of the Arrow; there are two or three viſible ones in the head, as many in the ſhaft, and one of theſe large; three or four in the ſquare at the middle, and as many in tho feathered part; of theſe there are none of a very conſiderable ſize, the three or four largeſt are of the fourth magnitude, for there is not one of the firſt, ſecond, or third, in it; there are two or three alſo of the fifth, but the greateſt number are of the ſixth magnitude.

The Greeks tell us, that this conſtellation owes its origin to one of the arrows of Hercules, with which he killed the eagle or vultur that gnawed the liver of Prometheus. The antients, when they performed their ſolemn ſacrifices, uſed to burn whole beaſts in the fire by way of offering to the gods. Prometheus, who found, that, at this rate, only the rich could be religious, made an order, that, in theſe ſacrifices, a part of the victim only ſhould be conſumed with fire, and the reſt eaten with reverence, and pious communion, by the people. When this cuſtom was eſtabliſhed, they tell us, that he made a ſolemn ſacrifice, and offering two bulls, all that he burnt on the altar was the liver of each, the fleſh of the two victims he put together in one ox's ſkin, and roaſted it for the attendants. The bones which he had taken out he alſo wrapt up in another ſkin, and, laying all together, he requeſted, they ſay, of Jupiter, to take what he pleaſed. They tell us, that the firſt permiſſion of ſaving a part was aſked of Jupiter, and that the gods, not being covetous like men, he obtained it eaſily; but this was an ill return; he ſeemed to have thought better of Jupiter than he deſerved, or elſe to have laid a trap to expoſe him, for, as all was now wrapt up and concealed, they tell you, Jupiter made the wrong choice, taking both to be bulls, he choſe the little one, and conſequently he got the bones. The deity, they ſay, in revenge, took away from mankind the uſe of fire, that, as they could not eat their meat raw, it might be of no uſe to them. Prometheus, after this, as they continue the ſtory, found his way to Jupiter's own fire, and ſtole ſome of it, and ſet all right again among his fellow-creatures. This is the original ſtory, but to this the ſucceeding fabuliſts added a multitude of things, as, that he made men, and many other ſuch matters. Jupiter, in revenge for the repeated inſult, they ſay, bound Prometheus to the mountain Caucaſus in Scythia, faſtening him down with an iron chain, and placed an eagle as ſome call it, or, as others, a vulture, which, piercing his ſide, fed on his liver, and returned to the prey as often as nature reſtored what it had deſtroyed. This vulture, or eagle, it is ſaid, was not of the ordinary breed, but was fabricated by the hands of Vulcan, and obtained its animating principle from Jupiter.

Long after this, they ſay, Jupiter was inclined to have been very well acquainted with Thetis, and took ſome pains to ſucceed. The fates, talking over the ſucceeding periods, ſet it down as a certain conſequence that Thetis ſhould have a ſon, who ſhould be greater than his father. Prometheus, who was in no condition to ſleep, heard the prediction, and he acquainted Jupiter with it. Jupiter, in return, ſet him at liberty. Hercules ſent after the Heſperian apples, and, knowing nothing of the place where they grew, went up to Prometheus, as they ſay, who lay bound upon the mountain, and obtained the knowledge he wanted from him, and afterwards releaſed him.

Schickard, who will make every conſtellation commemorate ſome piece of the Old Teſtament Hiſtory, calls this the arrow of Jonathan. Schiller, who will have them all refer to ſome part of the New, alters the figure, and makes it the ſpear and nails that wounded Chriſt.

SAGITTARIUS, *Sagittary, the Archer.* One of the conſtellations of the northern hemiſphere of very conſiderable note, and mentioned by all the aſtronomical writers. It is one of the old forty-eight conſtellations, and one of the twelve ſigns of the zodiac; ſtanding between the Scorpion and Capricorn. It is a large conſtellation, but, for its extent, it compriſes fewer ſtars than almoſt any other, and a great part of theſe are not conſiderable in their magnitudes; what there are of note in it, are, however, principally about the head and breaſt, and they are ſo diſpoſed as to be ſufficiently characteriſtic.

The figures of the zodiac are, in general, more natural than thoſe of many other parts of the heavens; the bears have tails, the dragons hairy heads, and the Dolphin is crooked, but the Ram, the Bull, the Crab, and the reſt of the zodiac ſigns in general, are like thoſe which are on the earth. This Sagittary, however, is an archer of the ſkies alone, for, on earth, there is nothing like to it. The figure we ſee given for it in all the ſchemes of the heavens, antient as well as modern, is that of a Centaur, or an animal half man and half horſe, armed with a bow and arrows, and the bow drawn, and the arrow ready to be let fly. The whole figure is naked, but there flows behind the neck a looſe kind of a robe; it is uſeful for compriſing a conſiderable number of ſtars, but, as the drawing ſtands, it is not eaſy to ſay in what manner it is faſtened to the body. The body, to the waiſt, is human, there begins the horſe; the body is bulky, and the tail that of an horſe, but it is ſingular that the hoofs are cloven. The bow is very large, and the poſture is that of walking, although the arrow is almoſt in the act of going forth.

The conſtellations between and among which Sagittary ſtand are Capricorn, Antinous, and the Eagle, Ophiucus, and the Scorpion. Capricorn is cloſe behind him, the forefoot of that figure, which is put forward, comes almoſt cloſe to the horſe's tail, Antinous is juſt over the flowing part of the robe of Sagittary; a part of the body, and the tail of the Serpent that is in the hands of Ophiucus, comes over the top of the bow, and, in ſome degree, over the head of the Sagittary, but at a conſiderable diſtance, and the Scorpion is juſt before him: the point of the Arrow ſeems levelled at the firſt joint of the tail, and but at a very little diſtance from it.

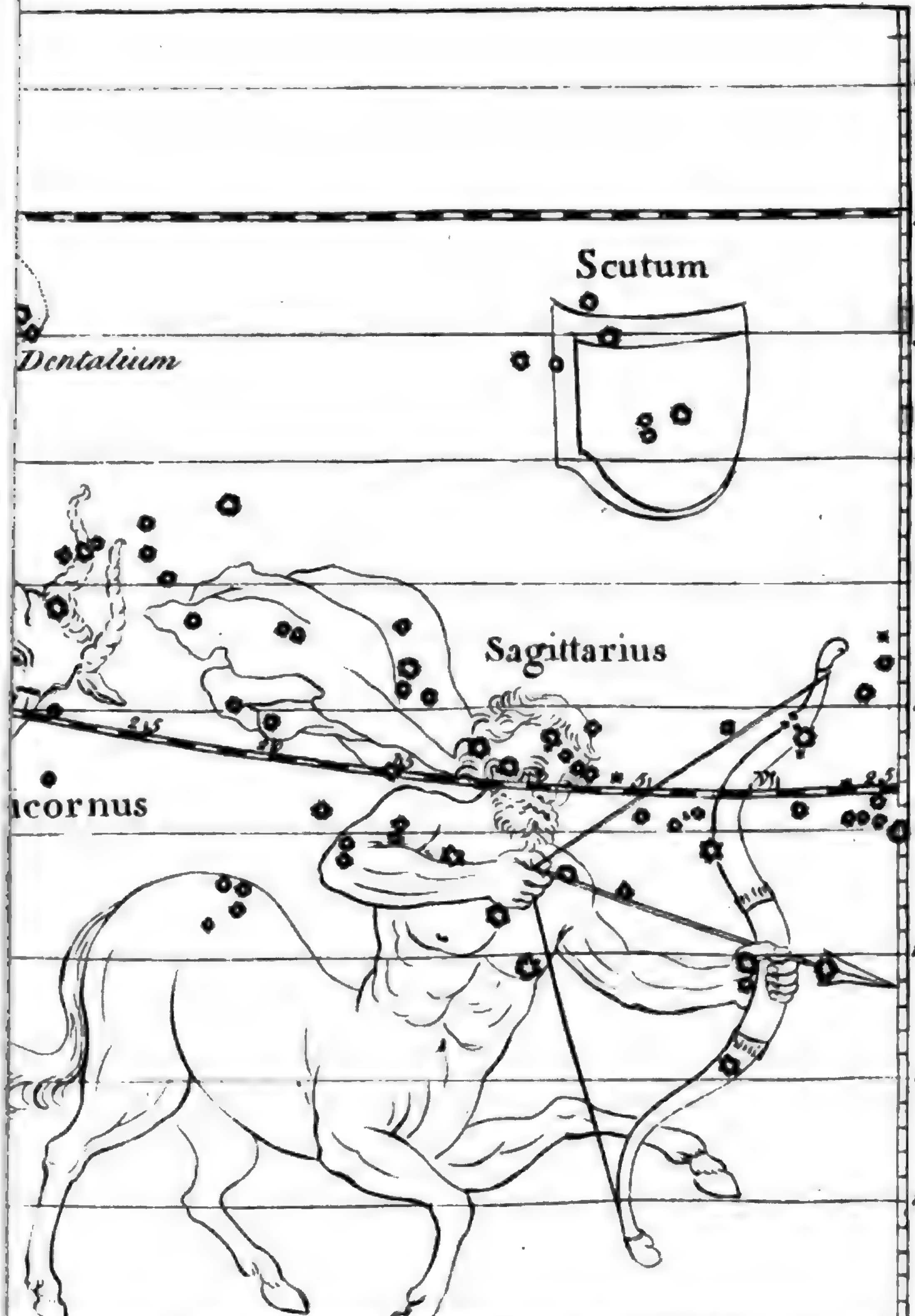
The antients counted thirty-one ſtars in the conſtellation Sagittary. Ptolemy ſets down ſo many, and from that we know this was the account in Hipparchus, the firſt among the Greeks who made a catalogue of the fixed ſtars, and whom Ptolemy ſtrictly copied. Tycho Brahe mentions only fourteen ſtars in this conſtellation; but Hevelius accounts for twenty-two, and Flamſtead has exceeded the common number of the antients a great deal, he makes them no fewer than ſixty-nine, of theſe, ſome of which are about the head and breaſt of the figure, and alſo ſome in the bow and arrow, ſeveral are very conſpicuous, and they are ſo happily diſpoſed, that all the figure is very determinate. There is not, however, one ſtar in the conſtellation of the firſt, or even an allowed one of the ſecond magnitude; there is indeed one in the ſouth part of the bow, which ſome have called of the ſecond magnitude, but they are more in the right

 who

who have allowed it to be only a third; all this however is arbitrary. There are, however, beside this, no less than five stars, allowed, on all hands, to be of the third magnitude, and these being all so near to one another as in the head and breast, and bow, make a very conspicuous appearance; one of these is placed at the base of the Arrow's head, a second in the shoulder, a third under the arm-pit, a fourth is the last of three in the head of the figure. There are, beside these, several of the fourth magnitude; the rest, in general, are of the smallest kinds.

The Greeks, who seem to have named the figure of this constellation just as it is to this time continued to us, have had many opinions as to its origin; they have been, at some times, inclined to call it a Centaur, but they have declared against this, because of the bow and arrows, which are not allowed to be the arms of a Centaur. Many of them have gone so far as to give a name to the figure, and, after that, it was easy to affix an history. They call him Crotus, and say that he was a son of Eupheme, who was a nurse of the muses; they say that the youth had his habitation on mount Helicon, and that he, in general, spent his time among the muses, but that he sometimes diverted himself with hunting. They add, he was the best poet and the best sportsman of his time, and that, in reward for his peculiar merit, the muses had requested of Jupiter to give him, at his death, a place among the stars, to which the deity consented, and made him one of the twelve signs of the zodiac. They say that Crotus was shaped like other men while he lived, but that this complicated figure was meant to commemorate his several excellencies. The bow and arrows, the ensigns of Apollo, to signify his power of verse; the horse-like part of his body to denote his exercises on that noble animal, and his use of it in hunting. They have thrown a crown before his feet, with which he seems playing, as above the wearing it; and the same mythologists say, that his satyr's tail was given to shew his love of Bacchus, and his happiness of celebrating that deity in his poems; it seems from this that we have a little departed from the old figure, for our Sagittary has as good an horse's tail as need be drawn, the hoofs also are divided, perhaps by the fancy of the painter, for the old writers do not mention this, but these are of no consequence.

Instead of all this idle matter among the Greeks, let us look up to the Egyptians for the origin of the figure, and we shall not be at a loss. They have the form preserved on their most antient remains, and they, doubtless, or their predecessors in Shinar, formed the constellation. Sagittary is the sign which the sun enters at the close of autumn, or at the fall of the leaf, and this before the rains of winter come on, is the sportsman's season. The Egyptians, or these their predecessors, had before figured the encrease of the flocks in spring by the Ram, the Bull, and the pair of kids, for that is the original Gemini in the zodiac; and they had for harvest placed a sun-burnt maid, a labourer in the field; what figure could they therefore chuse better to represent the approach of the hunting-season, than that of an archer, or a sportsman? Why indeed they joined the body of the man to that of an horse, we are not enough acquainted with their hieroglyphic language to attempt explaining. Whatever was the reason, all the astronomers in the succeeding world have continued the figure, except the Arabians, and they have departed from it, not from design or chance, but an unlucky necessity. The religion of these people did not permit them to draw, on any



Sagittarius

occaſion whatſoever, an human figure, this, though only in part human, was therefore unlawful; and they have kept up the intent of the Egyptians, though they have dropped the figure, by drawing a quiver in its place.

It was a cuſtom among the old writers on aſtronomy, to give one of the twelve ſigns of the zodiac to the protection of each of the twelve ſuperior deities. This fell to the ſhare of Apollo; and from this ſingle circumſtance we may trace the origin of all that jargon and nonſenſe which we find in the writings of the old aſtrologers, who tell us of a great affinity between the Sun and Sagittary; it is only from the giving the tutelage of this ſign to the god of day, whom they made conductor of the ſun.

We meet with ſome accounts of Diana, being the patroneſs of the ſign Sagittary, a thought which probably aroſe from the conſidering Sagittary as a hunter, and that deity as goddeſs of the chace. We are not to wonder if we meet with confuſion in things which are in themſelves ſo idle, and ſo arbitrary; but that Apollo was the tutelary deity of the ſign, at leaſt, among the Romans, is evident from the coins of Gallien, on ſome of which we have a reverſe the figure of Sagittary, and the words Apollini Conſervatori Auguſti, to Apollo, the tutelary deity of the emperor.

SAGITTIFER. A name by which ſome, who love uncommon words, have called the new conſtellation of the ſouthern hemiſphere, more uſually known by the name of the Indian; he has this name given him becauſe of the arrow in his hand.

SAH'M, *or* AL SAH'M. A name by which ſome, who are fond of uncommon words, call the conſtellation Sagitta, the Arrow; it is one of the Arabic names of that ſign.

SAKIB AL MA. A name by which we find the aſtronomers of certain periods call the ſign Aquarius; it is the Arabic name of that conſtellation, and ſignifies a pourer out of water.

SALKEIM. A name by which ſome have called the conſtellation Virgo; it is a Turkiſh word, and its proper ſignification is an ear of corn; it is uſed properly as the name of that ſtar in the ear in Virgo's hand, which is commonly called Spica Virginis, but ſometimes for the whole conſtellation; the Perſians call it Chuſhee, an ear of corn.

SAMACA, *and* AL SAMACA. A name by which ſome, who love uncommon words, have called the conſtellation Piſces; it is one of the two common Arabic names of that conſtellation.

SAMAN UGHRISI. A term by which we find the Via Lactea expreſſed in ſome of thoſe affected writers, who will go to the fartheſt part of the earth for an uncommon expreſſion. The ſenſe of the term is not the Milky Way, but the Way of Straw, and the origin of it is this, as the Greeks ſaid, that this part of the heavens was coloured by ſome milk from the nipple of Juno, the Egyptians ſay, it was from ſome burning ſtraw thrown all the way behind the goddeſs Iſis, in her flight from Typhon. This Iſis was their queen Semiramis deified, and Typhon, the giant, ſo famous in the Greeks, as well as Egyptian writers, for his enmity to the gods, is a landflood, a thing moſt terrible in Egypt in early times, and from one of which this very Semiramis eſcaped very narrowly herſelf, and not without the loſs of a favourite ſon. All the eaſtern nations follow the Egyptian, and call this lucid tract in the heavens not a way of milk, but a way of ſtraw.

SAMPSON. A name given by Schickard to the Engonafin of the early Greeks, and the Hercules of the fucceeding ones. Schiller will not be content with referring it to a part of the Old Teftament hiftory, but refers it to the New; he divides it into three figures, and calls them the Magi, or eaftern kings, that came to pay their adoration to our Saviour.

SAMPSON's HAIR. A name given by fome to one of the northern conftellations, the Coma Berenices. A fet of authors have rifen up who will not fuffer any figure in the heavens that has not reference to fome Chriftian, or, at leaft, to fome bible ftory. Thefe will not let the lock of hair be Ptolemy's queen's, but Sampfon's, or elfe Abfalom's, for fome call it his; but Schiller, the head of all thefe enthufiafts, will not fuffer it to be a head of hair at all, but fays, it is the fcourge with which our Saviour was whipped.

SANGUE, *or* AL SANGUE. A name by which fome, who are fond of uncommon terms, have called the conftellation Lyra; it is a barbarous term. A mif-fpelling only of the word Sengi, or Al Sengi, one of the Arabic names of that conftellation, derived from the Ciengh of the Perfian.

SARTAN. A name by which fome of the aftronomers, and the generality of the aftrologers, call the conftellation Cancer; it is the Hebrew name of the fign; the Arabic is Alfertan.

SATAN. A name by which fome have called the conftellation Sagitta, the Arrow. They have the word from Kircher, for he fays, that fign is called in Hebrew, Satan, or Dæmon.

SATELLITES. Certain little planets, attendant on the larger, and performing at the fame time their own revolutions round the bodies of thofe planets, and going with them the great courfe round about the fun. Thefe are a kind of fecondary, or fubordinate ftars. The fixed ftars are fo many luminaries hung up in the vaft expanfe of heaven, each fhining with its own light, as the fun does in our fyftem, and very probably each being a fun to a certain fyftem, and having planets rolling round about it.

The planets of our fyftem (for if there be any fuch about the fixed ftars, they are at too great a diftance to be vifible to us) are diftinguifhed in the heavens from thefe fixed ftars by their more fteady light. The fixed ftars, as luminous bodies in themfelves, dazzle the eye that gazes upon them, and have a twinkling which diftinguifhes them; the planets are bodies of earth and water, or, of fome other fuch principles: they are opake in themfelves, and only reflect to us the light which they have received from the fun. Thefe roll round the fun, as this earth on which we live does, it being properly one of them, and they are diftinguifhed, even by the fight, to be nearer to us than the fixed ftars. Saturn is known by his dead look, Mars by his ruddy afpect, Venus by being the brighteft in the firmament, Jupiter by being next to her in bignefs and brightnefs, and Mercury by his filvery luftre, and his nearnefs to the fun.

Thus are thefe two diftinct feries and orders of ftars diftinguifhed from one another; the fatellites are a third feries, and they are too fmall to be vifible to the naked eye, excepting our moon, which is truly one of them, and being fo near us, although fmall, appears fufficiently large, the others are difcovered by the ufe of telefcopes, and they make a beautiful appearance; thofe of Jupiter are the moft commodioufly feen, and of all make the prettieft

prettiest appearance. As the moon turns round this earth, enlightning our nights, by reflecting the light which she receives from the sun upon some part of the earth's surface which does not receive it; so they enlighten the planets to which they belong, and move round those planets in different periods of time, proportioned to their several distances: and as the moon keeps company with this earth in its annual revolution round the sun, so do they severally accompany the planets to which they belong in their several courses round that luminary.

It is impossible, that the existence of the satellites of any of the planets, except the moon, belonging to us, could be known before the use of telescopes. Those of Jupiter, which are four in number, were first discovered by Galileo in the year 1610, so very lately has the knowledge of astronomy arisen to its present height, and even now, with regard to these satellites of the other planets, it is not perfect. In speaking of the satellites, we distinguish them according to their places, into the first, the second, and so on: by the first satellite we mean that which is nearest to the planet.

As Jupiter, being more remote from the sun than this earth, has, instead of our one moon, or sattellite, four; Saturn, being yet more remote, has five; one of these was discovered by Huygens, in 1655, and this was the fourth, the four others were discovered by Cassini, the third and the fifth in 1671 and 1672, and the first and second in 1684. There is reason to suppose, that what is called the ring of Saturn, is no other than a congeries of satellites, but of this we shall speak hereafter under the article SATURN. We are here to consider only the satellites, which are distinct, and are allowed to be such, and which move round Saturn at different distances.

The proper revolution of the satellites of Jupiter and Saturn, in their orbits, is in the same direction with that of the primary planets, that is, according to the order of the signs, so that they appear in the superior part of their orbits, which is the part most distant from us, to go from west toward east, and in the lower part of their orbit, which is nearest to us, from east to west. Although, neither the satellites of Saturn, nor of Jupiter, could be seen by the naked eye, those of Jupiter will be distinguished with a very moderate assistance to it. They may be distinctly seen with a telescope of three foot, and they appear thus about equal to stars of the sixth magnitude, when seen by the naked eye. The satellites of Saturn are not to be seen so easily. The fourth, which was the first discovered, and is the most conspicuous, is not to be seen with a refracting telescope of less than eight foot, or thereabouts; the third and fifth may be seen by a twelve foot telescope, but the first and second will hardly be discovered with a refracting telescope of less than thirty-five feet.

We shall speak first of the satellites of Jupiter, and afterwards of those of Saturn. The satellites of Jupiter, like all others, receive their light as the planets do to which they belong, from the sun; and they are eclipsed by the shadow of Jupiter, in the same manner as the moon is eclipsed by the shadow of the earth; they also form eclipses of the sun upon the disk of Jupiter, as the moon does upon the surface of this earth, whensoever, in the course of their revolutions, they pass directly between the sun and that planet. This may be distinguished at this distance: we see it very plainly by the shadow, which they, at that time, cast upon the disk of that planet. These spots are distinguished very easily from those spots which are natural, and are a part of the matter.

matter of the planet, by the motions. Those, adhering to the surface of the planet, have no motion but with that of the planet, and are carried, together with that part of the surface to which they belong, regularly round in the revolution of the planet round its axis; on the other hand, these spots, which are the shadows of the satellites on the disk of the planet, have a motion peculiar to themselves, and in a direction like that of the satellite. These spots upon the surface of Jupiter, occasioned by the shadow of the satellites, and being, in effect, so many eclipses of the sun for the places where they happen, were first observed in 1664 by Cassini. Astronomers have taken a great account of them ever since.

When Jupiter is to the westward of the sun, which is the case from the time of his conjunction to that of his opposition, the shadow is occidental with regard to the satellite, which, in the lower part of the circle when it it is nearest to the earth, seems to run from east to west, and it is for this reason that the shadow enters the disk of Jupiter before the body of the satellite, and goes off before it. Just the contrary to this happens when Jupiter is to the eastward of the sun, which happens from his opposition to the time of his conjunction.

As the light of the satellites of Jupiter, which is reflected to us, is very nearly of the same brightness with that of the body of the planet, we frequently loose sight of them when they come before that planet; we sometimes are, however, able to distinguish, at the place where we ought to see them, a little obscure mark upon the surface of the planet. This mark is not only less dusky in its appearance, but it is also much smaller than their shadows when thrown upon the planet from the sun. This gives us an opportunity of knowing, that the satellites of Jupiter have obscure spots upon their surfaces, and are so much the more like our moon in that respect. These are not to be seen at any time, but when the satellite is making its transit over the body of the planet.

The shadows, which the satellites cast upon the disk of Jupiter, by intercepting the rays of the sun, appear oftentimes much larger than the satellites themselves, because we see only the enlightened part of the satellite, whereas the shadow is made by the whole globe, and is as large as its disk.

We not only distinguish very clearly that the satellites of Jupiter have a revolution round the body of the planet, but we see also many things that lead us to believe they have, at the same time, a revolution round their own axis. In the first place, in the time of their conjunctions with Jupiter, we sometimes see their spots in the place where the line, drawn from the earth to those satellites, would make them fall; and, at other times, with all the advantages of observation, and the same instruments, we do not see them at all in the places where we know they ought to appear, and where we, at other times, do see them; this can be only owing to one thing, which is, that one of the hemispheres of the satellite must be more spotted than the other, and that, when the spotted part is toward the earth, we can distinguish the satellite upon the disk of the planet, but, when the unspotted hemisphere is toward us, we cannot. This change can only happen from the satellites turning round upon their own axis, in consequence of which motion the spotted hemisphere will be sometimes turned toward us, and sometimes toward the planet.

We may observe, in the second place, that we see the same satellite sometimes larger, and sometimes smaller, while it is at the same distance from the disk of the planet. The fourth satellite

satellite sometimes appears smaller than any of the others in this observation; and, at other times, it appears larger than either the first or second: and its shadow upon the disk of the planet, when it intercepts the sun's rays, is, at all times, larger than the shadow of the first or second. The third satellite often appears larger than all the others, but sometimes we see it equal only to the first and second. This can be attributed to nothing else, but that the body of this satellite is spotted with obscure marks much more on one part of its surface than on another, and that it has a motion of revolution round its axis; for, in this case, as the brighter part was turned to us, the satellite would look larger, and, as the darker part, smaller; all the effect the spots on its surface could have, undistinguishable separately, at that distance, they would diminish the apparent magnitude of the satellite.

In the third place, we may observe, that the same satellite does not always take up the same time in entering on the body of Jupiter, or in going off from it, for sometimes we see it come on, or go off, in the space of ten minutes, whereas, at other times, it has been seen to do it in the space of six minutes and an half, taking very little more than half the time to do it on some occasions than it takes on others. This, however, is not a real, but only an apparent, difference, and is, like the others, an effect of the spots on the satellite. All the effect these have, at so immense a distance, is only diminishing the apparent bigness of the satellite, so that it seems, being less to pass, in less time. The period is, doubtless, the same at all times; but, as this period is the time taken up in the passage of the whole satellite, if we see only a part of it, or if we see the whole diminished to the quantity of a part, it will take up only a time proportioned to the whole ten minutes, as the part is to the whole of its apparent extent.

We might assert, that the spots of the satellites are temporary, that they appear and disappear at times, forming themselves a-new occasionally. This would answer all the purposes of the system, and this we know is, in reality, the case with the spots of Jupiter itself, which form themselves, and are destroyed again, and appear and vanish at times. This would explain these appearances of their different time of passing over the edge of the planet, as also that of their being seen differently, or not seen at all, upon his disk, in their passage over it, as well as the before-mentioned system, which supposes them to have a motion of revolution about their own axis. It would, however, require a supposition of very great, as well as very sudden, changes in the face of the satellites, of the appearance and disappearance of a strange multitude of spots, such as we see on no planet in the universe; and therefore, although consistent in manner, it would be, by no means, consistent in degree with the changes in the other planets; beside, it is best to refer things to the ordinary course of nature; and the same observations, which shew us, that no planet in the universe has such a sudden change of spots as would be necessary to effect this appearance, shew also that all the planets, so far as we have opportunities of determining it, have this motion of revolution about their own axis, which explains it full as well. Finally, when we are in this situation, we ought to be guided by the decision of other eminent astronomers in case of doubts, who unanimously assert, that, when there is the choice, we ought, at all times, to prefer the system, which explains appearances in the planet by local motion, in preference to that which is built upon alternate productions and dissipations of spots, and other appearances.

Sometime after the discovery of the satellites of Jupiter by Galileo, Pieresk set about to establish their theory, and to reduce their motions and appearances totally. He engaged in his design a number of persons of abilities. By the observations made by these different persons, compared with one another, and with his own, he soon determined the periods of their several motions precisely, or nearly; and, taking into his assistance, the observations of Galileo and of Kepler, he attempted a mechanical method of determining, at all times, the places of the satellites of that planet. This he extremely laboured, but he never published the full result of his attempts.

It is to him, however, that we owe the first hint of settling the true place of distant countries by this means; he recommended the viewing the configurations of these little stars in different places, and by that means to learn the true distance of those places, and to correct the maps of the world, and perfect navigation. He had this tried very carefully; he had observations taken in many places, and particularly at Aleppo, as well as in France and elsewhere, but, after a number of these trials, he gave up the thought, confessing, that, though they promised fairly, they were not sufficient. He saw it after this in the light of a much less general thing than he had originally flattered himself it would prove, and he, as hastily as he had taken it up, abandoned the enterprize. He gave it up absolutely on his own foundation, but he still entertained hopes, that, under the application and improvements of others, it might sometime be brought, if not to absolute perfection, at least to great utility. The Dutch were, at this time, busy in attempting the longitude; Galileo and Kepler engaged themselves in it in the service of those states, and attempted it on this very plan of Pieresk; he thought there was a probability of that's flourishing in their hands, which had not succeeded in his own, (such true modesty accompanies merit) and he expected the event with an impatience, and a hope of success, little less than theirs who are immediately engaged in it.

Galileo continued his application twenty years on this single point, and at that time dropt the attempt, not for want of hope, but for want of sight. This was esteemed a public calamity; the attempt could be carried no farther, and the interest and assistances of all the powers of Europe, who were now crouding in to his support and encouragement, were useless. Hortensius, Bleau, and many of the most eminent mathematicians of the age, were deputed to serve and to assist him in it, but it was too late, and the calculations, necessary for compleating the tables as the great designer had intended them, never could be executed.

Reineri, the author of the Medicaean tables, (which comprehend the most celebrated astronomical tables that had been made for about four hundred years, reduced into one form, under the protection of the great duke of Tuscany) succeeded Galileo in this great attempt. He continued, for many years, his observations on the satellites of Jupiter, which Galileo named the Medicaean stars. He at first proposed tables of them which should serve to discover the longitude, and he laboured on this plan a vast while, and went so far as to promise them to the public in the first impression of his tables published in the year 1639; but in the second impression of those tables, which is corrected and augmented greatly from the first, he says not one word concerning these tables which are to serve for finding the longitude. He was too hasty in the promise, as Pieresk was in his expectations; both set out with assurance of success, but both

found

found greater difficulties in their way than they had imagined. The world never was informed of the result of the pains he absolutely used to this purpose; his very papers were not to be found after his death, although the great duke, his patron, took a particular care to have them sought after. It is not improbable that he destroyed them himself, as not having answered his expectations, and being improper to leave behind him for a comparison with the happier labours of some succeeding astronomer; for it is certain, that all, who had yet laboured in this attempt, although they found it too long a task for their own lives, believed it would be sometime accomplished.

Hodierna, a little time after this, published his tables, but, although accurate in a great degree, they contained the observations only of a short space of time after: a little time more could not represent so much as the configurations of the satellites; and Marius, hurrying himself that he might get out his tables before those of Galileo, did not succeed at all better.

Others, at that time, and since that time, have made attempts to find out the longitude by the satellites of Jupiter, but they do not seem to have been determined in what manner it was best to set about it, or what faces of the satellites they were to chuse for this purpose. In 1664, Horigonus proposed what he thought the best manner in these terms. An observation is to be made with an excellent telescope, at what hour of the time of viewing, any one of the satellites of Jupiter comes to the line that shall pass from the edge to the centre of the planet. But this method is impracticable, because the satellites are usually not visible at the time when they are at, or near this line, which is carried from the eye to the centre of Jupiter, as has been already observed in speaking of their passages over, or before the disk of the planet; in which they are not visible at all, even to the best telescopes, unless it happen, that, at that time, they are in such a position from their revolution about their axis, that they shew their most spotted surface. Beside, supposing this objection removed, there is not one of them that would be found in this line more than twice, four times, or, at the utmost, six times, during the twelve years of Jupiter's revolution. This will happen from their apparent latitude, the laws of which are not yet perfectly known.

Cassini set about this work with precaution, he made a multitude of observations himself, and he procured also a multitude of observations to be made by others, as well in the same place as at different places. He found that the satellites of Jupiter had certain phases, which were more proper than others for this great work of determining longitudes, and, on comparing all these, he found that the most favourable of all, for this essential purpose, were those of the eclipses, which the several satellites suffered in passing through the shadow of Jupiter. We may see either the entrance into the shadow, in these, or the passage out of it, and sometimes both the one and the other, and this in so precise and accurate a manner, that two observers, who take their account separate, shall not differ a quarter of a minute of an hour. This is an exactness much greater than could be had in the observation of eclipses of the moon, which had been proposed for answering this purpose. Among these, the eclipses of the first satellite he found would determine the matter better than those of any other, as its motion, being quicker than that of either of the others, its entrance into the shadow, and its passage out of it, would be more sudden, and consequently

quently might be determined with the greatest precision.

Next, after the eclipses of the satellites of Jupiter, (for they are, doubtless, of all other of their appearances, the most proper for determining of longitudes) we shall find their apparent conjunctions with Jupiter, and with one another, the most favourable opportunity, especially when they happen on their meeting from opposite parts. The observation of the shadows, which the satellites form upon the disk of Jupiter, when they pass between the sun and that planet, may also be useful to this purpose, especially when they pass over the middle of his apparent disk; but these less than either of the others.

Nor is it only the satellites of Jupiter that may be useful for this purpose. There are certain fixed and apparent spots on the body of the planet, which might be very well made objects of observation with the same intent. These are sufficiently plain at all times, and they have a motion of revolution about the body of that planet, which is quicker than any other with which we are acquainted among all the heavenly bodies. The passage of these spots over the middle of Jupiter's disk, however, cannot be determined with so much exactness and precision as that of the shadows of the satellites.

The accurate observations that have been made by astronomers of the motions of Jupiter's satellites, with intent to this determining of longitudes, although they have not perfectly succeeded as to that design, yet have occasioned a great many discoveries with respect to their motions. We find that the orbits, which they run through, in their passage round about Jupiter, are a little inclined to the ecliptic, and that they describe, in appearance, extremely narrow ellipses, so narrow indeed, that, at certain times, they do not differ from a strait line. These appearances have greatly contributed to the determining their motions, for, with exception only to the fourth satellite, which passes sometimes, although not often, over or under the disk of Jupiter, we see them, in the course of each of their revolutions, eclipsed in passing either before or behind the disk of the planet. This gives the means of determining the times of their revolutions about the planet. The method is extremely simple, and requires only the knowing the true place of Jupiter in the time of two of his oppositions, and of the entering of the satellite upon, and its passing off from, the disk of the planet. This is all that is required for the foundation, since this shews the time it has taken in passing through the centre, but, as it sometimes will happen, that, on the day of the opposition of Jupiter with the sun, there are no eclipses of any of his satellites, or, that the season may not be favourable for the observing of them, there are other methods as certain, though less easy, of determining their mean movements by any two *observations*. The principles of this are laid down in their proper places in this work, and we shall not encumber this general account of the satellites with a repetition of them.

On comparison of the result of the two methods (for that is the most certain way of judging) we find that the first satellite of Jupiter, or that which is nearest to the body of the planet, revolves in one day, eighteen hours, twenty-eight minutes, and thirty-six seconds. The revolution of the second satellite is performed in three days, thirteen hours, seventeen minutes, and fifty-four seconds. The third takes seven days, three hours, fifty-nine minutes, and thirty-six seconds; and the fourth, which is the most distant, performs one revolution only in sixteen days, eighteen hours, five minutes, and seven seconds. This

is

is the exact period of the several revolutions.

As at the return of the satellites to their conjunction with Jupiter, they perfect a complete revolution in their orbits, plus an arc, equal to that of the motion of Jupiter in his revolution round the sun; it is necessary, in order to have their revolutions, with regard to a fixed point in the heavens, to take off, from each of those which has been set down, the time which that particular satellite has taken to describe an arc, equal to the mean movement of Jupiter for the time of that revolution.

Although the orbits of Jupiter's satellites be circular, or of a figure approaching to circular, yet, on occasion of the inclination of their plane to that of the cliptic, they seem to us to describe very narrow ellipses, and indeed often appear to move in absolute strait lines; this we know to be natural to ellipses, or even to circles, seen in such directions as these orbits are seen in at those times, according to the laws of optics and perspective. This direction, in the plane of their orbits, necessarily occasions an apparent inequality in their motions: they seem to move quicker, the nearer they are to the body of Jupiter, and more and more slowly, as they are farther off to the end of their greatest digressions, when they appear stationary for some time, because the arc which they do, at that time, describe in their orbit, is nearly in the same direction with the visual ray, reaching from the eye to the satellites; these are therefore, for this plain reason, the most convenient of all times for the determining the diameter, which their several orbits occupy in the heavens, and their respect to the orbit of Jupiter, to which it is necessary to compare them, in order to know the times, and the duration of their eclipses. Their greatest digressions do not differ sensibly from the greatest diameter of their orbits, and in finding one, the other is discovered.

The proportion of the diameter of the orbits of the satellites to that of the planet itself, may be determined by observing the interval of time which is between the entrance of the centre of one of the satellites on the disk of Jupiter, and its passing off from it when these eclipses are central; for that is the occasion on which they are of the longest possible duration. As the time which the satellites takes in making its revolution, is to that of its continuance behind the disk, or before, or upon the disk of Jupiter, so are three hundred and sixty degrees to the number of degrees which measure the arc, which the disk of Jupiter occupies in the orbit of the satellite, and therefore as the sinus of the half of that arc is to the total sinus, so is the semidiameter of Jupiter to the semidiameter of the orbit of its satellite.

We may also employ, on this occasion, the eclipses of the satellites in the shadow of Jupiter, when we can see on the same day their immersions and emersions, as in the third and fourth satellite, chusing the term of their longest stay under the shadow of Jupiter. According to these several methods we have found, that the first satellite of Jupiter, when it is in the greatest digression, was distant from the centre of the planet five semidiameters, and two thirds of a semidiameter of Jupiter, the second, nine semidiameters of Jupiter, the third, fourteen, and twenty-three sixtieths, and the fourth, twenty-five semidiameters, and eighteen sixtieths.

The apparent diameter of Jupiter occupies in the heavens, when he is nearest to the earth, fifty-one seconds; and when he is most distant from the earth, thirty-two seconds. This gives his bigness, seen from the sun, at his mean

mean distance, at forty-two seconds and a half; hence we find the diameter of the orbits of the several satellites.

The diameter of the orbit of the first satellite is three minutes and fifty-five seconds, the diameter of the orbit of the second is six minutes and fourteen seconds, that of the third is nine minutes and fifty-eight seconds, and the diameter of the orbit of Jupiter's fourth satellite, seventeen minutes and thirty seconds.

It has been observed before, in laying down the theory of the planets, that the orbits which the moon describes about the earth, and the earth and planets about the sun, are elliptic, and that they run on describing, in equal times, unequal arcs. This is what produces the inequality in their motions with regard to the forms of those ellipses, where the earth and the sun are placed. The same appearances we must observe ought to be remarked with regard to the revolutions of the satellites of Jupiter about that planet; however, as the greatest part of the irregularites which we discover in their motions, ought to be referred to another cause, we generally speak of them as if they described circles, or orbits nearly circular, about the body of that planet. It has been already observed, that, on account of the excentricity of the orbit of Jupiter, with respect to the sun, the mean revolutions of his satellites ought to differ from their apparent revolutions, with respect to Jupiter, in a quantity equal to the difference between the true and the mean movement of that planet. As the true place of Jupiter in his aphelion, is the same with his mean place, we see that this inequality ought to begin from his aphelion, and to distribute itself afterwards throughout the whole course of that planet about the sun, in the same manner with the equation of its orbit, and that to have the mean motion, we are to take off from the true. From this it follows, that the time which the satellites take to make their revolutions about Jupiter, with regard to the sun, must be more quick than their mean revolution when that planet is between his aphelion, and his mean distance; and that those revolutions must be, in the following time, slower when Jupiter is in that part of his orbit, which is from his mean distance to his perrihelion.

From this consideration of the appearances and theory of Jupiter's satellites, we shall pass to those of Saturn; these are five in number, as has been already observed, and they appear, even to the best telescopes, very small, in proportion to those of Jupiter. As these satellites have their light from the sun, in the same manner of the other planets, they must appear greatly more faint than those of Jupiter, their distance from the sun, as well as from the earth, being double that of that planet. Hence it is, that although, in the course of their revolutions, there are times in which, with respect to us, they pass before or behind the planet, and should be seen upon his disk, or covered by his shadow, yet their distance, and the faintness of their light, proportioned to that distance, is such, that we have never seen any of their eclipses, nor been able to remark their immersion, or their emersions.

We find it very difficult indeed to distinguish the first and the second satellite at all, when they approach the body of Saturn; this is owing to the same cause, and this has doubtless been the occasion that it was so long before astronomers discovered that there were any such satellites. We have not, from the same cause, been able to observe them in the course of their revolutions, when the ellipses which they describe, by their proper motion, have the greatest breadth, and they pass before or behind that planet.

With

With regard to the third ſatellite, it is ſomewhat larger than the two others that are nearer to the planet, and there are times when we can obſerve it during the courſe of its revolution; the caſe is the ſame alſo with regard to the fourth and fifth ſatellites, which becauſe they are more remote from Saturn, are very rarely hid by the diſk of that planet.

We obſerve great variations in the apparent magnitudes of Jupiter's ſatellites, but it is not thus with regard to the four firſt of Saturn, the fourth of theſe at all times appears the largeſt and faireſt, but it is not thus with regard to the fifth ſatellite, this ſometimes appears larger than the third, but, at others, it diminiſhes its apparent brightneſs and magnitude, in ſo ſurpriſing a manner, that it becomes abſolutely inviſible, and continues in this diſapparent ſtate a certain time, the period of which is not yet perfectly determined; this happens uſually when that ſatellite is in the eaſtern part of that orbit with reſpect to Saturn.

It has been already obſerved, that the ſpots, (as there are undoubtedly ſuch on the ſatellites of Jupiter) could not appear to us as ſpots, but being on ſuch comparatively ſmall, as well as remote bodies, would only diminiſh to us their apparent magnitude. On this ſuppoſition, which is founded on reaſon and obſervation, it will be natural to judge, that this fifth ſatellite of Saturn has alſo on its body ſpots extremely large in proportion to its own bulk, and on this plan we ſhall have ſome conjecture as to its diſappearance. Theſe ſpots may be principally on one hemiſphere, and when in the courſe of its revolution, that hemiſphere is turned to us, it may be inviſible, although, at the times when any other part of its ſurface is toward us, it may reflect a ſufficient quantity of light to mark its place in the heavens; this may happen from the ſpots not being permanent, but it is much more likely to happen from the revolution of the ſatellite, round its own axis, in conſequence of which it preſents ſometimes one face to us, and ſometimes another; to this purpoſe it is not neceſſary, that a whole clear face be exhibited at one time, or a whole ſpotted face at another, by a ſudden ſhift, for this is not the appearance. The ſatellite does not diſappear at once, but becomes gradually ſmaller and ſmaller, and, at length, is quite loſt; this may be, as more and more of the diſk, or ſpotted hemiſphere, becomes turned toward us in its revolution, till at the laſt the whole is loſt to us, and we ſee nothing.

It will be obſerved in ſpeaking of Saturn, that the ring which encompaſſes that planet, preſents, to the earth the figure of an ellipſis; at times more, and, at other times, leſs open; at ſometimes it becomes more and more narrow, till it, by degrees, wholly diſappears, and, at others, it grows more and more broad, till, at length, its leaſt diameter is nearly the half of its great axis. It is exactly thus with reſpect to the planes of the orbits of the ſatellites of this planet; the four firſt of them deſcribe ellipſes, which are very like to that of the ring, and their motion is made in a right line at the times when that ring does not appear. With regard to the fifth ſatellite it has been obſerved, that, at certain times, it runs in a right line, while the others are deſcribing ellipſes; from this it is evident, that the orbit of that ſatellite is not in the plane of the ring, nor of the other ſatellites, but that it has a motion to itſelf in a peculiar direction.

The ſatellites of Saturn are, in the ſame manner as thoſe of Jupiter, ſubject to certain irregularities in their motions, which depend upon the motion of Saturn round the ſun, and, for this reaſon, to determine their mean move-

movements, the same methods are to be used as in determining those of the satellites of that planet. It must be remarked, however, that as the inclination of their orbits is much greater than that of the orbits of the satellites of Jupiter, it is necessary to chuse from among those observations, which we shall compare together, those when Saturn was nearly in the same part of his orbit, and the satellite at the same distance from its conjunction with that, preferring those times when the ellipses which they describe, by their apparent revolutions, are the most open, for at that time their true places in their orbits have no occasion for reduction. We are also, in the enquiry into the mean motion of Jupiter's satellites, to have regard to the chusing those observations of their conjunctions with that planet; or, at least, those which are the least distant from their conjunctions, because their apparent motion is quicker, then than in any other part of their orbit.

According to these methods of computing, it has been determined, that the first satellite of Saturn persoms its mean revolution, in regard to the point of Aries, in one day, twenty-one hours, eighteen minutes, and twenty-seconds; the second in two days, seventeen hours, forty-four minutes, and twenty-two seconds; the third in four days, twelve hours, twenty-five minutes, and twelve seconds; the fourth in fifteen days, twenty-two hours, thirty-four minutes, and thirty-eight seconds, and that the fifth satellite of Saturn takes up in its revolution seventy-nine days, seven hours, and forty-seven minutes.

As to the diameters of their orbits they are not so easily determined as those of the satellites of Jupiter; but the sum of the enquiries on that head results to this, that calling the diameter of the ring of Saturn *one*, the diameter of the orbit of the first satellite will be *one*, and fourteen fifteenths, very nearly double. That of the orbit of the second satellite will be two and an half, that of the third, three and an half, that of the fourth, eight, and the orbit of the fifth satellite twenty-three, to one of the ring.

When the fifth satellite has appeared to move in a right line, it has been found, that its node, viewed from the sun, answered to the fifth degree of Virgo, seventeen degrees distant from that of the other satellites.

There have not been wanting those who have supposed the planet Venus to have satellites attending her in her revolutions about the sun, as the moon does our earth, but it is improbable. Cassini, the accuracy of whose observations is very little questioned, was at one time of that opinion, but he did not continue perfect in it. Gregory, taking up the observation of that writer concerning the disappearance of the fifth satellite of Saturn at times, from its having a dark face, or an hemisphere, covered with *dusky spots*, at that time turned toward us, but extended it to this phœnomenon, or supposed phœnomenon, and supposed, that Venus may have a satellite, but that it may have so great a part of its surface dark, as to be very seldom visible. It is thus those who take up arguments at second-hand, will carry them farther than their authors. This may be the case, as represented, with regard to one of the satellites of Saturn, and that the most remote from his body; but to suppose an almost wholly dark satellite to a planet, which should have but one, is absurd; and it is not indeed in the course of nature, that Venus, so near as she is to the sun, should have one, because she cannot want any. These are but conjectures, though they are strange ones, but we have what amounts to a proof as nearly as a negative can be proved, that there is no such thing,

because

becaufe in the many accurate obfervations that have been made by Bianchini, and others, on that planet, in a better climate for the obfervations than either France or England, that fatellite had then been one, would have been at fometime feen.

SATURN. One of the planets, performing their revolutions round about the fun, and the moft diftant of them. When we look at this planet in the heavens by the naked eye, it is eafy to diftinguifh him from a fixed ftar by the fteadinefs of his light. Thofe ftars have a peculiar brightnefs, which makes them twinkle to the fight, and fuch of the planets as want this, for Mercury and Venus being very near the fun have fome of it, have yet a brightnefs; but Saturn the leaft of them all. Saturn is thus diftinguifhed at fight in the heavens, he appears more dead and dull in his light than Jupiter, and lefs ruddy than Mars, indeed fcarce any ftar, except fome of the fmaller among the fixed ones, makes lefs appearance in the firmament.

How little does the uninformed eye imagine, that while directed to this faint fpeck of light, it is contemplating a large and glorious planet, and one of the moft ftupendous bodies of this fyftem; a planet whofe diameter is eight times as great as that of this earth. The earth's diameter is not quite eight hundred miles, and that of Saturn is feven thoufand, its fuperficies is equal to twenty-two times that of the earth, and its real quantity, or folid contents, fix hundred and twelve times that of the earth.

We are not, however, to be fo much amazed at this vaft bulk of Saturn, in proportion to the appearance his globe makes in the heavens, for we are to confider, that all objects decreafe in their apparent magnitude in proportion to their diftance, and the diftance of Saturn is immenfe, and vaftly over proportioned to that of any of the other planets. The earth is no more than eighty-two millions of miles diftant from the fun, a diftance immenfe, as it appears, yet, comparatively, little. That of Saturn, from the fun, is feven hundred and eighty millions of miles. The revolution of a planet round the fun is what conftitutes the year of that planet, the earth being at eighty-two millions of miles diftant from the fun, performs her revolution in three hundred and fixty-five days and a quarter. The times of thefe revolutions are proportioned to their diftances, and that of Saturn is accordingly no lefs than ten thoufand, feven hundred, and fifty-nine days, and a quarter; this is the year of Saturn, as the three hundred and fixty-five days are our year. What a length, in comparifon to ours! it makes no lefs than between twenty-nine and thirty of our years. It is not only that his orbit is vaftly large, but his motion is the floweft of that of all the planets; and it is not a wonder, when we confider this immenfe diftance at which he receives the light of the fun, and the diftance through which he is to fend it back to us, that he appears the fainteft of all the planets; any more than that he appears the leaft of all, although he is, in reality, fo very large. Saturn is called a primary, and one of the fuperior planets. What is meant by primary is, that he originally revolves round the fun; this term is ufed in diftinction from the fecondary planets, or fatellites, fuch as thofe revolving round this planet and Jupiter, as alfo the moon, which is a fecondary planet, or the fatellite of our earth; thefe being carried round fome other planet, and with it round the fun: by this term fuperior, is underftood above the earth, or more diftant from the fun than the earth is. Mercury and Venus are called inferior

planets,

planets, being lower than the earth, or nearer to the ſun; Mars, Jupiter, and Saturn, ſuperior, or more diſtant, and Saturn moſt.

Notwithſtanding that, in viewing Saturn by the naked eye, nothing ſingular is ſeen in him; it is much otherwiſe when we ſee him through teleſcopes. Some of the firſt diſcoveries that were made with thoſe inſtruments were on this planet, and it will be no unentertaining obſervation to ſee by what ſlow degrees the aſtronomers arrived at a knowledge of his form and attendants.

Galileo made Saturn one of the firſt objects of his obſervation, and he ſoon perſuaded himſelf that he ſaw, on each ſide of this planet, a ſingle ſtar, which was immoveable, and fixed to the body of the planet. The appearance of Saturn is indeed very ſingular, and ſo perfectly unlike to all other objects of the creation, that we cannot wonder at errors about it. One of his firſt accounts ſays, that he had diſcovered, to his aſtoniſhment, that Saturn was not one, but three ſtars, touching, or nearly touching, one another, and always preſerving the ſame ſituation with reſpect to each other; that in the middle he ſaid was much larger than the ſide ones; theſe he ſaid were diſpoſed in a right line from eaſt to weſt, not exactly according to the direction of the zodiac, but ſo that the weſtern ſtar was a little elevated northwards. When he gave this account, he had employed ſome time in the reſearch, for he gives with it many obſervations. He ſays, that, if teleſcopes of ſmaller power were uſed, the three diſtinct ſtars were not ſeen, but Saturn appeared of an oblong figure, or like an olive; but that, when he uſed ſuch glaſſes as magnified one thouſand times, he could ſee diſtinctly the three ſtars, the large one in the middle, and, on each ſide, one of the little ones ſo near to the ſurface of the great one, that only a fine dark thread ſeemed to part them. It was not to be ſuppoſed, that he, who had made ſo ſtrange a diſcovery, would deſiſt there; he continued his obſervations on the planet, and, in a little time more, he diſcovered that theſe two ſtars, which he had deſcribed as accompanying Saturn, were ſubject to certain variations. It was in November, 1610, that he publiſhed his firſt obſervations, and, in leſs than a month, he added to them, that they began to diminiſh in magnitude; and, in his obſervations publiſhed in 1612, he ſays, that they had continued diminiſhing more and more, till they had, at that time, quite diſappeared. At this time, he ſays, the body of Saturn was round and plane like that of Jupiter, and there was no trace nor veſtige of the former ſingularity. This change of appearance he endeavours to account for, but, as his conjectures are vague, they have no place here. It will be agreeable to trace farther the diſcoveries of Saturn's true form, but the errors about the imaginary are needleſs. *Galileo never went* farther than the ſuppoſing Saturn occaſionally thus to change his appearance from that of a tripple to that of a ſingle ſtar; but the aſtronomers, who ſucceeded him, continuing their obſervations, attributed to this planet, at different times, a ſtrange variety of figures, which appeared very odd to themſelves, and more ſo to the world. But it was near fifty years before his true form was diſcovered; this was done by the accurate Huygens; he, in the year 1659, gave his ſyſtem of that planet's form and motions, and publiſhed with it all the conjectures of others.

Huygens diſcovered, that what had occaſioned all theſe ſeveral appearances in Saturn, was a moſt ſtrange appendage to the planet, a circular ring, flat, and detached from the body of the planet on all parts. This ring, being viewed obliquely from the earth, muſt neceſſarily

ceſſarily have appeared, according to the laws of optics, in form of an ellipſis, more or leſs open, according as our eye is more or leſs elevated with regard to its plane, which is inclined about thirty degrees to that of the ecliptic. From hence it reſults, that, according to all appearances, when our eye is in the plane of the ring, it muſt wholly ceaſe to appear, unleſs its thickneſs were ſufficient to let it reflect a quantity of the ſun's rays to us, ſufficient to make it viſible. He found that the exterior ſemidiameter of this ring was, to the ſemidiameter of the globe of the planet, as nine to four, and that its breadth was equal to that of the ſpace between its interior edge and the globe of the planet.

To the figure of Saturn, and the form, diameter, and diſtance of his ring, all which were diſcovered and aſcertained by Huygens, very little has been added ſince, that regards the immediate body of the planet.

We ſee, on ſome of the other planets, ſpots, in ſome degree, reſembling thoſe on the moon, but nothing of this kind has been diſcovered on Saturn; all the variation of its ſurface, that has been diſcovered, conſiſts in two belts, the one much fainter than the other; theſe appear much plainer at ſome times than at others, and are in the direction of the great diameter of the ring. Sometimes, when the ring has quite diſappeared, and the planet appeared round like the others, three obſcure belts, or bands, have been diſcovered running parallel with one another. This was the caſe in 1719, when many obſervations were made at the royal obſervatory at Paris, and thoſe who made them knew how to judge concerning what they ſaw; they eaſily perceived that the middle belt of the three was no other than the ſhadow thrown upon the body of the planet by its ring. This was fainter than the other two, and of thoſe the northern was determined to be ſmaller than the ſouthern, and ſo they have appeared to the beſt obſervers ſince. The diſpoſition and figure of theſe belts, as ſeen at that time, or at any other time diſtinctly ſince, compared with the accounts given of them as ſeen at other times, will lead us to know what they are. The north and ſouth belts, as ſeen in 1719, were in a right line, and at the ſame time parallel to the third, or middle one, which was formed by the ſhadow of the ring upon the body of the planet. This ſhews, that they were in a plane parallel to that of the ring, and that their figure was like that of the ring, conſequently that they were circular. By the accounts of former obſervations it appears, that two other ſuch belts or bands, as thoſe ſeen in 1719, had been obſerved on Saturn in 1696; all the difference was, that thoſe of 1696 were much narrower than thoſe of 1719; they were ſeen to be exactly parallel with the exterior ſurface of the ring on the ſouth, and they had a little curvity, which had its convexity toward the anterior part of the ring. This appears as well by the deſcriptions given of them at that time, as by the figures which ſeem ſufficiently accurate. The ſmalleſt diameter of the ellipſis is that which the ring of Saturn forms; by its appearance it was ſomewhat leſs than half the meaſure of the larger, and the elevation of the eye above the plane of the ring was about twenty-ſix. From this it follows, that, if the belts or bands, ſeen in 1696, had been adherent to the ſurface of Saturn, they would have been ſeen in form of ellipſes, the breadth of which would have been equal to a little leſs than half their length. But this does not at all agree with the obſervation, for they had only a little bending, ſuch as there would have been in an ellipſis, the larger diameter of which ſhould have been nearly equal to that of the exterior circumference of the ring.

On many other occasions there has been a single belt seen on the body of Saturn, and there has not been discovered in it that degree of curvity, which should have been required according to the elevation of the eye above the plane of the ring. From all this it has been concluded, that these belts are not really adherent to the globe of Saturn, but that they are really placed at a great distance from its surface, in such a manner, that we discover, on the body of that planet, only a part of their circumference, the curvity of which ought to be according to the rules of optics, much less sensible than that of a parallel ellipsis, which should be to the surface of the planet; the surplus of the circumference of these belts, which cannot be discovered by telescopes, must be of a matter less proper for reflecting the sun's rays, which has led the late astronomers to conjecture, that they are, in some degree, like the clouds which are about this earth, and which intercept a certain quantity of rays of light, without having power to reflect any. These clouds having a curvity like that of the exterior circumference of the ring, they ought therefore to be nearly at the same distance with that from the surface of the planet, and consequently the atmosphere, in which they are placed, ought to entirely surround the ring. These belts of Saturn have, by some, been taken for seas, and, by others, dry land, the rest of the surface being water, and thence reflecting the light more strongly. But this is a much more rational solution, and, as supported by such observations, cannot be easily overthrown.

From what has been already said of the ring of Saturn, it will appear, that all the changes Galileo describes in the planet, were owing to it. He saw the two enlightened points of it, which were beyond the globe of the planet, in his first observations, and, seeing no more, he took these for stars. When the ring was in a situation in which it could not be seen, these stars disappeared, and the planet was round like the others. In the same manner we are also to understand the accounts of the ears and and handles of Saturn; they were appearances of the same parts of his ring which Galileo had taken for stars. There is not indeed any thing in the whole system of nature more wonderful, than this ring surrounding Saturn; it is solid, and of a matter fit for reflecting light, for it reflects nearly as much as the planet itself, and appears very nearly as bright as any part of the surface of the planet. There is something very singular in the form of this lucid ring, and it is particularly remarkable that its thickness, in no proportion, answers to its breadth; it must indeed be very little, for, when the edge is turned toward us, it never is seen at all, even under the most favourable circumstances, but the whole ring disappears; although the sun's rays fall fully upon it, and we are in a situation to receive them both by reflection, yet, in this case, we have none. The use of the ring being, doubtless, to enlighten the globe of the planet, this indeed is not necessary, for the thickness would be of no use in comparison with the breadth; but this is strange, that a body of such extent should have so little. The whole appearance is strange; the whole is held suspended round the body of the planet without touching it in any part, and is like a large flat circle that should surround the globe of our earth, and its plane pass through the centre of the earth.

The distance, at which Saturn is placed from the sun, must render the rays, which it receives from that luminary, less vivid, and his globe so large withal, that a great deal of additional light must be requisite, according to the proportion of nature, in regard to the other planets. We find these, as more remote

mote from the ſun, and, as larger, enlightened with more ſecondary aſſiſtances. Our earth has its ſingle ſatellite, the moon; Jupiter, larger, and more remote than the earth, has four moons, or ſatellites; and Saturn, greatly more diſtant, has alſo his ſatellites, or moons, (but they are ill ſuited to his diſtance) in the ſame proportion. This lucid ring is, undoubtedly, given him to ſupply the place of an additional number; nay, to ſpeak more plainly, this ring, moſt probably, is a greater number of moons, or ſatellites, proportioned to his diameter, and the diſtance of his orbit. It is very hard to conceive what this ring ſhould be, or how ſupported, at the ſame diſtance from the body of the planet, if, as aſtronomers in general ſeem to ſuppoſe, it be a flat and broad bottom. Is it not much more probable, that it only appears continuous and ſolid from the diſtance, and that it is, in reality, compoſed of a vaſt number of ſatellites, or moons, diſpoſed in the ſame plane, and making their revolutions round the planet? This were to give Saturn a quantity of moons indeed proportioned to his diſtance from the ſource of light. It is eaſy to conceive that theſe may be ſo ſmall as not to be ſeen diſtinctly and ſeparately at this diſtance, but that they may be ſo near to one another, that their blended light may make one continued blaze, and may give the whole the appearance of a continued body. We are ready to ſuppoſe nature uniform in her operations, and ſimilar on ſimilar occaſions. We ſhould find her ſufficiently ſo on this ſuppoſition, though not at all ſo on any other. The ring of Saturn, conſidered as aſtronomers have ſuppoſed it to be, a broad flat ring of ſolid matter, ſuſpended round the body of the planet, and, keeping its place without any connection with the body, is quite different from all the appearances, as well as all the real accidents, of the other planets, and is therefore to be ſuſpected of error in the obſervation. But if we ſuppoſe, that a number of ſatellites are placed in the ſame, or nearly in the ſame plane, ſmall, and near to one another, and make their revolutions round the planet, this will keep them in their places without a miracle, though they do not touch the body of the planet; and, if we ſuppoſe them thus ſmall, and thus ſituated, they will form ſuch a ring in appearance, and they will diſappear at certain times; that is, in certain ſituations, becauſe they want ſize to give the neceſſary thickneſs. Indeed, if we conſider the great diſtance of the planet, we ſhall find that ſuch a glorious aſſemblage of moons may be neceſſary to him, and that they will anſwer, in all points, to what we ſee of his belt in our obſervations.

There is only one natural objection to this opinion, but that ſhall be ſtated fairly. It may be urged, that theſe ſatellites, (ſuppoſing the ring to be compoſed of ſuch) ought to be ſubject to the ſame laws of nature with thoſe others we know, and that, according to the rule laid down by Kepler, the ſquares of the times of their revolutions ought to be as the cubes of their diſtances from the body of the planet. Now, if it were thus, it will be ſaid, the ring, being compoſed of this multitude of ſatellites, thoſe of the ſeveral different parts of which are at different diſtances from the planet, the ſatellites near its exterior edge being greatly more remote than thoſe toward its interior, would be ſubject to great irregularities in appearance; for theſe different ſatellites, having different degrees of motion proportioned to their different diſtance, could not keep always in this equal diſpoſition, ſo as to form a ring of equal breadth all round the planet; but that, as we ſee among the other ſatellites, as Jupiter for inſtance, that they are, ſometimes, all of

them

them behind the body of the planet; fo in thefe, a great many would be hid, at other times a great many before, and frequently clufters in fome particular parts, and deficiencies in others; the confequence of which would be, that the ring would be fometimes narrower, or, in fome places, narrower or broader than in others, and, perhaps, fometimes interrupted in its continuity. The objection is fairly ftated, and it may be fairly anfwered; if we fuppofe that there are different circles, all formed of fatellites, round the body of the planet, and that there are as many of thefe circles as are neceffary to make the breadth of the ring, the fatellites, difpofed in each circle, will all of them make their revolutions in the fame time, as they will be at the fame diftance from the planet: and this being the cafe with all the circles, they will therefore never change their fituation with regard to one another. A firft circle of fatellites, all preferving the fame diftance from one another, will thus revolve regularly round the planet; beyond this, another circle of more diftant (but all equally diftant) fatellites, performs, behind thefe, its revolution alfo in the fame manner, according to the laws eftablifhed by Kepler; that is to fay, the time of the revolution of this fecond circle fhall be to the time, or period, of the revolution of the firft circle, in the refpect in which the diftances of the two circles from the centre of the planet require. Now, according to this, the fame parts of the firft circle will not continue to anfwer to the fame parts of the fecond; but this will make no difference in the appearance of the whole, for ftill fome part of a firft circle, of equally diftant fatellites, will anfwer to fome part of a circle of equally diftant fatellites, and it is the fame thing to us whether this be one part or another, fo it be fome part in the fame proportion, which muft happen. There will be no change in the total appearance, but the whole will be exactly the fame as if the two concentric circles of fatellites had performed their revolutions in the fame time, and this is to be extended to all the circles. We fuppofe the whole breadth of the ring compofed of a due number of circles of fatellites, all equally diftant, and performing their revolutions in this manner; thofe of the fame circle, in the fame time, as being equally diftant from the centre of the planet, and confequently continuing equally diftant from one another; thofe of the fecond in a longer time, thofe in the third in a yet longer, and fo of the reft. The feveral fatellites, of any one circle, all this time keep the fame period of revolution with one another, and confequently the fame diftance from one another. The confequence plainly is, that a part of each circle will be always feen againft a part of the next, and fo on; nor is it any matter which part of either, all parts of any one being alike. Thus we *fhall* always fee a lucid circle compofed of parts of fo many, always of the fame breadth. This will make the ring of Saturn anfwer all the appearances, and thus the laws of Kepler, inftead of overthrowing, countenance and fupport this fyftem.

But it is not even neceffary to make thefe fatellites, which compofe the ring of Saturn, fubject to thofe laws which Kepler has eftablifhed with regard to the other fatellites. If we were not inclined to allow fuch an arrangement as has juft been laid down of the fatellites, compofing the ring of Saturn, into fo many circular feries, we might ftill account for their appearance under that form. We might conceive them to be an irregular congeries of little moons together, making up the broad figure of his belt, and placed with ever fo much uncertainty, but we might fuppofe them

them near enough to Saturn to be within the extent of his atmosphere; in that case, while they retained their fixed situation with regard to one another, they would, all together, be carried round about with the body of the planet, in its revolution on its own axis, without being subject to Kepler's laws, which, although they are just as well as ingenious, need not have force with regard to those bodies which are within the atmosphere of the planet. This would absolutely solve the appearance according to the laws of optics and of gravitation, but the other is much more probably the case.

Beside the ring of Saturn and his satellites, there has been nothing particular observed by the astronomers concerning him, except what are called his belts. There are, on the body of Jupiter, certain broad bands, or, as they are called, belts, which are taken for seas; and, on Saturn, there have been, as observed at certain times, seen also sometimes one, and sometimes two belts, which have been thought similar. Some have mentioned a third between the two seen at certain times, but this is evidently no more than the shadow of his ring cast upon his body. As to the others, they are not, as they appear, marks immediately upon the body of the planet; the different angles, under which they are seen, sufficiently demonstrate this, as has been already proved. It suffices to say farther, that they are at a distance from the surface of the planet, and are probably formed by exhalations converted into a more dense form in his atmosphere, and are of the nature of clouds.

When we observe the sun, we may, according to all appearances, conceive him as revolving round the earth; when we regard the moon, we see she actually does so, but it is not thus with regard to the planets; they move round the sun, and even the most simple observations will shew that they do so. The motions of these, and among these, the motions of Saturn, form different appearances of him with regard to the earth, in proportion to his different aspects with the sun. It is therefore evident, that Saturn revolves round the Sun in common with this earth, and not round this earth, as the sun appears to do.

We may indeed, according to the system of Ptolemy, represent the motions of the planets, with respect to the earth, equally well in supposing them to turn about an epicycle; but it is contrary to the (now) known laws of nature, to suppose that one of the heavenly bodies revolves round an imaginary centre. We know gravitation to be the law by which they are impelled, and there can be no gravitation where the centre is not real. It is therefore more consonant to reason, and, as so, is now universally acknowledged, that Saturn, and the other planets, do revolve round a certain centre, which is the sun, and that centre is to be regarded as the principle of their motion.

The sun being then fixed in the centre of the universe, let us consider the orbit of the earth at a certain distance from the sun, the orbit of Saturn at a vastly greater distance, and the firmament, as another circle, vastly remote beyond the orbit of Saturn. Having established thus much, it will be easy to understand the motion of Saturn, and his different appearances, according to that motion.

In this observation, Saturn being seen from the earth, as corresponding to a certain point in the firmament, would, if viewed from the sun, be seen to correspond not to that, but to another distant part of the firmament. To know what is the true place of Saturn, as seen from the sun, it is necessary to determine

the distance between Saturn and the Sun, with respect to the distance between the earth and the sun; this is done by the method of resolving rectilinear triangles, and the distance between the true place of Saturn, seen from the earth, and its true place, seen from the sun, will be thus known; but as we cannot do this by immediate observations, we are obliged, in order to effect this perfectly, and to ascertain, without error, the true place of the planet, as seen from the sun, to have recourse to those occasions, when the true place of the planet, seen from the earth, is in the same direction with its place, as seen from the sun; and this happens at the times of the conjuncture, or opposition of the planet with the sun, when the earth is in a right line with the sun, and with Saturn. In some of these conjunctions the light of Saturn is too faint to be perceived from the earth, and this planet is hid behind the sun, when its north or south latitude does not exceed the semidiameter of the sun; from these reasons we can only employ those conjunctions which happen at different degrees of the zodiac, and which give the true place of Saturn, seen from the sun in the different parts of its orbit; these are very useful observations, but they take up a great deal of time to make them answer any purpose, for the interval between each is a year, and some days.

In determining the mean motions of Saturn, we compare together the times at which that planet has returned to the zodiac after one or more revolutions, and this enquiry would be sufficient, if Saturn, when he came to the same point of the zodiac, was, at the same time, found in the same situation in his orbit; that is to say, if his aphelion and perihelion were at all times directed toward the same points of the heavens. For the equation of the same planet being the same, at the same distance from its aphelion and perihelion, there would then be no difference between the true and the mean motion of the planet, contained in any number of its revolutions.

It is not thus, however, when the aphelion, and the perrihelion of a planet, are subject to any movement; for, in that case, the same points of their orbits, do not answer to the same points of the heavens; whence it follows, that the equation of a planet, which one observes in the same part of the zodiac, is not found to be the same sometime after, when there have been in the interval several revolutions.

Thus the exact determination of the mean movement of Saturn, requires that of the movement of its aphelion, and consequently its situation at different times; it requires also a knowledge of the equations of that planet at all the degrees of its orbit, in order to take account of the difference between those equations, in the comparison of the antient and the modern observations, and to reduce its mean place to its true place, which is one of the principal elements in the theory of the planets.

In order to find the aphelion of Saturn and his greatest equation, we may employ all the methods laid down by astronomers for determining the apogee of the sun and the moon. *(See these under the article* APOGEE.) But then we are to observe, that the motions of the sun and moon are to be considered from the earth, round about which they seem to make their revolutions; and thus all the exact observations, which have been made to the present time, may serve to the knowledge of these two elements; whereas, in regard to the other planets, which do really move round about the sun, we can use only their oppositions with the

the ſun, which, with regard to Saturn, happen only at the diſtance of a year and ſome days. The catalogues of obſervations, publiſhed by aſtronomers, will be uſeful to this purpoſe, and the method of employing them has been already laid down.

We are to conſider, that although the ſituation of Saturn in the heavens is generally mentioned as with regard to the ecliptic, the orbit deſcribed by that planet, in its proper motion, is on a plane inclined to the ecliptic; from this it reſults, that the motions of that planet, reduced to the ecliptic, do not anſwer to thoſe places when it is effectually found in its orbit. It will therefore be neceſſary, on many occaſions, to reduce the true place of Saturn, obſerved, with regard to the ecliptic, to its true place in its own orbit, and reciprocally, when we know the true place of the planet in its orbit, to be able to reduce it to the ecliptic; this requires a knowledge of the inclination of the orbit of Saturn, and of the places of its interſection, with the ecliptic, which are its nodes.

The moſt ſimple method of determining the true place of the nodes of Saturn, and their epocha, or the time of the planets returning to them, is to obſerve the time when that planet has no latitude with regard to the ecliptic; for the ſun and the earth being at all times on the plane of the ecliptic, when Saturn, in the interſection of his orbit with the ecliptic, is on the ſame plane, that planet has no latitude with reſpect to the earth, nor with reſpect to the ſun; and the time of the obſervation determines the epocha of the node of Saturn, without any reduction.

With reſpect to the true place of the node of Saturn, it is neceſſary to examine whether that planet be, at that time, in an oppoſition with the ſun, or be diſtant from it. When Saturn is in oppoſition, the true place of his node, ſeen from the ſun, is preciſely the ſame with the true place of that planet ſeen from the earth. When Saturn is not in oppoſition, we are to reduce the true place of Saturn, ſeen from the earth, from his true place, ſeen from the ſun, which will be, at the ſame time, the true place of the node of Saturn, correſponding to the epocha, or to the time of the given obſervation.

It is eaſy to ſee, that as Saturn is near thirty years in performing one of his revolutions, he paſſes only twice in about thirty years through the ecliptic; and conſequently, that the obſervations for the determining his nodes, by this method, can only be made once in fifteen years, and it is alſo neceſſary beſide, that Saturn be not found near his conjunction with the ſun at that time; add to this, that there are ſeveral months in which we find no opportunity of ſeeing this planet, and that a favourable ſeaſon is neceſſary alſo to the making theſe obſervations, and under all theſe conſiderations, we ſhall find the opportunities but rare; they are not to be miſſed therefore when they do happen.

Notwithſtanding that the creator has provided ſo glorioufly for the illumination of this vaſt planet, the light which it receives can be but in a very moderate proportion, as immediately coming from the ſun, and the heat from the ſame ſource, the ſun, muſt be alſo leſs in the ſame proportion than with us, ſo that, according to all appearances, Saturn could not be habitable by creatures, formed like us, nor his globe produce things like to ours. The diſtance of Saturn from the ſun, we ſee is ten times greater than that of the earth from the ſame luminary, and conſequently, according to the known rules of decreaſe of apparent magnitude, with encreaſe of diſtance, the ſun will appear an hundred times leſs to that planet than to the earth.

What are we to suppose the condition of those inhabitants, (if the planets all have inhabitants) who, from their cold orb, see the sun, which is to us the source of all our pleasures, only about twice as large as we see the planet Venus.

In mentioning what might be a secondary explication of the ring of Saturn, as understood to be a congeries of satellites, we have spoke of a possibility of their being carried round together with that planet, in its revolution round its own axis; this might be the case, supposing them placed at so small a distance from his surface, as to be within the compass of his atmosphere; but we have not given that as the right solution. This would indeed have been liable to cavil, since it is not certainly known, that the globe of Saturn does turn round upon its axis; nay, some have doubted much whether it does so; there is this in favour of the supposition, that he does not, that the planets, which we see revolve about their axis, the earth itself not excepted, have the equaterial diameter of their globe greater than the polar diameter and that this is not discovered to be the case with Saturn. We have not indeed the common opportunities of determining whether this planet does revolve about its own axis, for we see nothing of those spots and marks upon his surface which are the most obvious, and immediate of all proofs, of such a motion in the others. What have been fancied under the name of belts, being only clouds, and the globe of the planet appearing at this immense distance quite uniform; but as all the other heavenly bodies, the sun, and to our knowledge some of the fixed stars, and most probably all, have that motion; it is most natural to suppose, that Saturn also has it, and that he is like the other planets, in this particular, though too remote to suffer us to determine it by an immediate observation.

SCALENOUS CONE. A cone which does not stand upright. When the axis of the cone is inclined to the base, or makes an accute angle with it, of whatsoever extent, it is called a scalenous, or an oblique cone, in distinction from that whose axis is perpendicular, and which is *right*. *See* CONE.

SCARABÆUS. A constellation offered to the astronomical world, and formed of a cluster of conspicuous stars, which occupy a little space in the heavens, left between the constellations Ophiucus, Libra, and Scorpio.

The species of Beetle, under the out-lines of whose form these are arranged, is that singular and beautiful one, known by the name of the Rhinoceros Beetle, and preserved in all the cabinets of the curious; it is represented in a posture of moving, with his back toward the leg of Ophiucus, and its horn turned up towards his thigh.

It is a very small constellation, but in proportion to the extent that it occupies in the heavens, it contains a sufficient number of stars, and these, in general, very conspicuous: they have been used to be accounted among the unformed stars of the other constellations, but this is so uncertain, and confused a method of speaking of them, that it is certainly better to have them, like the stars of those constellations, arranged under the lines of some figure, and much more familiar and perspicuous; for instance, to call one of them the upper or the lower star in the horn of the Beetle, than by any number of the unformed ones of such a constellation, though with the addition of a letter from Bayer.

The Scarabæus is situated but at a small distance from any of these constellations which are about it. The whole space left between the three is not equal to more than half

half one of the ſcales of the balance, and the little conſtellation is nearly in the middle of it, but nearer to the two others than to Ophiucus. The Serpent is over the Beetle's head, its horn runs parallel with the arm of Ophiucus, and is pointed, as before obſerved, at his thigh; one of the ſcales of Libra is under the hinder part of its belly, and its rump is turned to the Scorpion, almoſt touching the extremities of two of his fore legs.

The conſpicuous ſtars in the Beetle are nine, they ſtand in a pretty cluſter, and ſome of them are very conſpicuous; there is one in the extremity of the head, juſt at the inſertion of the horn, this is a ſmall one, but in the horn there are two both large, and very conſpicuous, one of theſe is toward the inſertion, and not at a great diſtance from that at the root, the other is more than twice as far from that, as that is from the firſt, this is a very bright ſtar, and ſtands at the tip of the horn; at the joining of the head to the back there is alſo one, and that a bright ſtar, and there are two in the legs, one at the extremity of the firſt, and the other at the extremity of the ſecond leg; there is alſo one on the lower out-line of the body, at the inſertion of the thigh of the hinder leg; and one almoſt oppoſite to this, at the out-line of the back. The ninth, or laſt ſtar in the Beetle, is at the extremity of its rump, and comes between the toes of the firſt and ſecond leg of Scorpio.

SCHABTAI. A name by which ſome, who are fond of uncommon words, have called the planet Saturn; it is the Hebrew name of that planet, and the word in that language ſignifies reſt. It is naturally enough given to the ſloweſt of all the planets in its motion.

SCHAORO. A name by which ſome, who are fond of uncommon words, have called the moon; it is one of the old Chaldee names of that planet.

SCHEMASH. A name by which thoſe, who are fond of uſing uncommon terms, call the Sun; it is one of the Hebrew names of that luminary, and ſignifies heat; but the word Sun ſufficiently expreſſes all that we mean by the name of that body, and it is idle to uſe any other.

SCHEMATISMA. A term by which ſome of the Greek writers have expreſſed what the Latins call Conſpectus Stellarum, and the aſtrologers, of our time, aſpects of the planets, and certain of the conſtellations, or ſingle ſtars; theſe were certain mutual radiations of thoſe planets and ſtars on one another, under the influence of which the cant of that ſtudy was, that they co-operated together, and that, from theſe, events were to be preſaged.

SCHEME, *or* FIGURE. A term borrowed by aſtronomy from the mathematics, and uſed to expreſs a ſurface, or an extenſion of quantity in length and breadth, when it is terminated and incloſed every way by lines. If this ſurface be flat, and in no part either raiſed or depreſſed, when it is thus circumſcribed, it is called a *plane figure*.

This figure may be incloſed by two lines, if one, or both, be crooked; but it cannot be circumſcribed by leſs than theſe, if they are all ſtrait. Two curves will encloſe it, or one curve and one ſtrait line, but two ſtrait lines never can, ſince there muſt be, between theſe, at one extremity, or at both, an opening, and the ſurface therefore is not encloſed there, but runs out into indefinite ſuperficies, and therefore there is not a figure.

 The

The ſtrokes, that encloſe this ſurface, are called the circumſcribing lines, and the quantity of plane ſurface, contained within them, is called the area of the figure.

SCHEMSO. A name by which ſome, who are fond of uncommon words, call the ſun; it is the Chaldee name for that luminary, but we have no occaſion to adopt it.

SCHENDRA. A name by which ſome, who are fond of uncommon words, call the moon; it is a name under which that planet has been worſhipped by the Indians.

SCORPIO, *the Scorpion.* One of the conſtellations of the northern hemiſphere, and of the twelve ſigns of the zodiac. It is one of the forty-eight conſtellations of the antients; and is mentioned by all the writers on aſtronomy.

The Scorpion is not a very large conſtellation, but, for its extent, it contains a conſiderable quantity of ſtars, and ſome of them very conſpicuous. It is indeed as ſtrongly marked in the heavens as any of them all. The conſtellations of the zodiac are all tolerably well drawn in the ordinary ſchemes of the heavens. Some of the others are monſters, bears with long tails, twiſted dolphins, and hairy-headed dragons; but this is a tolerably accurate figure of a large ſcorpion; it does not ſtand ſo firmly on the ecliptic as ſome of the others, but is repreſented as if tumbling off from it.

The conſtellations, between and among which the Scorpion is placed, are Sagittary, Ophiucus, Libra, and the Wolf. Sagittary is behind it, but at ſome diſtance, its head is directly toward Libra, and the two fore claws come very near the two Scales; Ophiucus is placed over it, his right foot on the body of the Scorpion, and the head of the Wolf is below it, the mouth touching one of the feet, or claws of the Scorpion.

The Scorpion, excluſively of his claws (in the place of which the conſtellation Libra has been placed) contained, according to the antient accounts, ſeventy-four ſtars; Ptolemy ſets down ſo many, and he accounts, beſide theſe, ſeventeen others to the claws, or to our Libra; but Flamſtead has raiſed the account much higher than that of the antients, he makes them forty-four.

Of theſe there is one of the firſt magnitude, a very bright and beautiful ſtar, it ſtands on the body of the conſtellation, and makes a very beautiful figure. They have called a bright ſtar, of the firſt magnitude, in the breaſt of the Lion, Cor Leonis, the Lion's Heart; and they call this, in the ſame manner, Cor Scorpionis, the Scorpion's Heart; but its ſituation does not quite ſo well anſwer to that appellation. There are two, by ſome, allowed to be of the ſecond magnitude, but both diſputed by others in this particular, and reduced to the third, though they are very large for that claſs; the one of theſe ſtands in the middle of the forehead, and the other in the ſting at the end of the tail, with another bright one of the third magnitude very near it. There are ſeveral of the third magnitude, which are very conſpicuous ſtars, one is in the third ſouth foot, though ſome will have this to be a ſtar only of the fourth magnitude; another is the ſouth of three in the forehead, another in the firſt joint of the tail, and another at the foot of Ophiucus, which touches the Scorpion. There are alſo ſeveral of the fourth and fifth magnitudes, beſide the leſſer ones; with all theſe conſiderable ſtars, we are not to wonder that a conſtellation ſo ſmall as the Scorpion (for ſo it is in compariſon of the others) is very conſpicuous. The ſmaller ſtars

ſtars add to this, for they are diſpoſed very luckily, according to the out-line of the body of the creature, and upon, or cloſe by, its claws.

The Greeks, who would be ſuppoſed the inventors of aſtronomy, and who have, with that intent, fathered ſome ſtory or other of their own upon every one of the conſtellations, give a very ſingular account of the origin of this. They tell us, that is the creature which killed Orion. The ſtory goes, that the famous hunter of that name boaſted to Diana and Latona, that he could deſtroy every animal that was upon the earth; the earth, they ſay, enraged at this, ſent forth the poiſonous reptile the Scorpion, and that inſignificant creature ſtung him, and he died. Jupiter, they ſay, raiſed the Scorpion up into the heavens, and gave it this place among the conſtellations, and afterwards Diana requeſted of him to do the ſame honour to Orion, which he at laſt conſented to, but placed him in ſuch a ſituation, that, when the Scorpion riſes, he ſets.

The Greeks went much too far in theſe hiſtories of their conſtellations. The Egyptians knew nothing of their Hercules and the reſt of their heroes, nor, if they had known of them, would they have named conſtellations in the zodiac from them. They placed this poiſonous reptile in that part of the heavens to denote, that, when the ſun arrived at it, fevers and ſickneſſes, the maladies of autumn, would begin to rage. This they repreſented by an animal whoſe ſting was of power to occaſion ſome of them, and it was thus they formed all the conſtellations.

The antients allotted of the twelve principal among their deities to be the guardian for each of the twelve ſigns of the zodiac. The Scorpion, as their hiſtory of it made it a fierce and fatal animal that had killed the great Orion, fell naturally to the protection of the god of war; Mars is its tutelary deity, and to this ſingle circumſtance is owing all that jargon of the aſtrologers, who tell us, that there is a great analogy between the planet Mars and the conſtellation Scorpio. To this alſo is owing the doctrine of the alchymiſts, that iron, which they call Mars, is alſo under the dominion of the ſame conſtellation, and that the tranſmutation of that metal into gold can only be performed when the ſun is in this ſign.

When the aſtrologers talk of any particular ſtar as being of the ſame nature with any particular planet, they mean, that the light of that fixed ſtar is tinged with ſome faint dye of the ſame colour with the light of that planet. Thus all thoſe of the fixed ſtars, which are ruddy, are ſaid to be of the ſame nature with the planet Mars; thoſe, which are bluiſh, of the ſame nature with Saturn, and ſo of the reſt; but, when they ſpeak of a whole conſtellation as being of the ſame nature with a planet, they only mean, that it was attributed, by the antients, to that deity, by whoſe name alſo one of the planets is called. It is not clear that they always underſtand themſelves in this; but here is the meaning and foundation of the fancy.

SCORPIONIS FORCEPS, *the Claws of the Scorpion.* A term under which Ptolemy, and many other of the earlier aſtronomers, as well as ſome of the later, among whom is Copernicus, have ſpoken of that ſign in the zodiac, which is, by the generality of writers, called Libra. We may ſee, by this little inſtance, what would have been the effect of new-naming all the conſtellations according to the original deſign of the venerable body, who, being offended at the names of the Ram and the Bull, called thoſe conſtellations by the

the name of St. Peter and St. Andrew, and was for carrying up the twelve apoſtles into the zodiac. Schiller has improved upon him, and new-named all the heavens, but nobody has followed them. We ſee, by the confuſion occaſioned ſolely by the double name of this one ſign, an infinite deal of perplexity would have followed the altering them all; for, at preſent, men ſcarce know what they are ſaying to one another, when one follows Ptolemy and Copernicus, and the other the reſt of the aſtronomical writers.

The occaſion of this diverſity of names for the conſtellation, now called Libra, is, that, originally, there were but eleven conſtellations to the twelve diviſions of the zodiac. In order to a conſtellation to every diviſion, or ſign of this circle, they propoſed, very early, in the improvement of this ſtudy, to retrench the Scorpion, which, at this time, occupied the ſpace of two ſigns, and to place, in that diviſion where his claws had been put, the figure of Julius Cæſar holding a balance in his hand, as we ſee him in ſeveral of the engraved gems of the antients, and on ſome baſs-reliefs. This was done at once, but it was not at once allowed. We, in general, now allow, however, of the Libra, and the claws of the Scorpion are cut off.

SCOURGE. A name by which enthuſiaſtical people have called the conſtellation Coma Berenices, or Berenice's Hair. Schiller, and his followers, unwilling to have any old or new conſtellation in any but holy hiſtory, will have this, which Conon intended to expreſs a lock of hair, to be the ſcourge with which our Saviour was puniſhed; others make it Abſalom's famous head of hair; and others, that of Sampſon, with which he loſt his ſtrength.

SEA-CALF, *Phoca*. One of the Arabian conſtellations, it ſtands in the place of Andromeda. The Arabians were forbidden, by their religion, to draw human figures, and they therefore did this.

SEA-GOAT. A name by which ſome have called the conſtellation Capricorn, from its being, in the upper part only, a goat, in the lower, a fiſh.

SEASONS. The aſtronomers divide the year into four ſeaſons, but they do not count theſe exactly as other people reckon them, to make the ſame periods, which diſtinguiſhed them, to mark alſo certain remarkable periods of the ſun's motion; they count them from the days of the tropics, and the two ſtations of the ſun at the equator. The ſpring they begin at the tenth of March, the day in which the ſun's place is, for the firſt time in the year, in the equator, and on which his diurnal motion is in the celeſtial equator. The ſummer they begin on the eleventh of June, when he is in his greateſt declination north, or the tropic of Cancer. The autumn they begin on the twelfth day of September, the day on which his place is again at the equator, and his diurnal motion in the celeſtial equator; and the winter on the eleventh of December, the day on which his place is at the fartheſt point of declination ſouth, and his motion in a parallel called the tropic of Capricorn.

SEBU. A name by which ſome, who love uncommon words, have called the conſtellion Lupus; it is one of its Arabic names, and the word, in that language, ſignifies, at large, a wild beaſt, and not particularly a wolf. This is conſonant with the cuſtom of the other nations, for it was not at firſt called a wolf.

SECHEZ. A name by which ſome, who are fond of unuſual words, call the planet Mercury; it is one of the Egyptian names of that planet, and is, by ſome, ſuppoſed to be only another name for Seſac. Others make it ſignify an attendant. This is a very likely meaning, becauſe we find, in many other languages, this planet is called by names, the ſignification of which is the ſame, and the occaſion of this ſeems his being ſo cloſe an attendant on the ſun, or ſo much nearer to him than all the other planets.

SECOND. Conſidered as a meaſure of ſpace, is the ſixtieth part of a minute, which minute is the ſixtieth part of a degree, which degree is the three hundred and ſixtieth part of a circle; the third is a ſixtieth part of the ſecond, and ſo on. *See* CIRCLE.

SECONDARIES, *or* SECONDARY CIRCLES. A term uſed to expreſs certain circles drawn in the ſphere of the heavens from any given place, ſo as to interſect one another in the vertical points, or in the zenith and nadir of the place: theſe are called vertical circles, or azimuths. When they are called ſecondaries, the term horizon is underſtood, and it is meant to call them ſecondaries of the horizon; for any great circles, that are drawn through the poles of another great circle, are called ſecondaries to it. As many of theſe imaginary circles as we pleaſe may be drawn through any part of the ſphere, and, provided they all interſect one another at the poles of the horizon, they will all be vertical circles, ſecondary circles, and azimuths, (for the terms are ſynonymous) to that horizon. In order therefore to underſtand properly what are the ſecondary circles, we ſhould firſt conſider the primary.

The horizon, on which all theſe azimuths are dependant, is then a great circle of the ſphere, the plane of which is ſuppoſed to paſs through that point on the earth's ſpherical ſurface, where the perſon ſtands, and extended every way to the region of the ſtarry heavens; or, it is a great circle of this nature, the plane of which paſſes through the centre of the earth parallel to the point of the earth's ſurface on which the obſerver ſtands. Theſe may ſeem to make two different horizons, but, in reſpect to the heavens, they are the ſame, for they coincide; they are, however, different in name, the one being called the ſenſible, the other the rational horizon. There is alſo another epithet uſed in ſpeaking of the horizon, that is, the viſible horizon. This and the reſt are to be explained before we proceed on the explication of thoſe terms, which regard circles that are dependant on this of the horizon.

The viſible horizon then is that part of the earth's ſurface which is to be ſeen at one view, or from any one place. This is ſmaller when the obſerver ſtands on the ground, than when he is on a tower or church, or any other elevation, as it is a greater circle when ſeen from an hill than a plane; and the occaſion of this is the earth's convexity, more of a convex ſurface, of any kind, coming in view from the elevation than from a plane.

The ſenſible horizon is not a view limited to a little part of the ſurface of this globe, but is an extent ſo great, that the whole globe of the earth is, in itſelf, a point, or thing of no bigneſs, or conſideration, in the compariſon. If the plane ſtone, on which I ſtand on a pavement, be conceived to be extended every way to the ſtarry region of the heavens, it would be the mark of my ſenſible horizon, for the horizon is not a fixed circle, but is different to the perſon who ſtands on a different part of the globe.

The

The rational horizon, finally, is a circle extended to the starry heavens, in manner of the other, but whose plane, instead of passing through the point of the earth's surface, on which the observer stands, passes through the centre of the earth parallel to that plane, and is so continued.

Now the surface of the earth, and the centre of it, being remote by a vast multitude of miles from one another, it might be supposed, that the sensible and the rational horizon, at the starry heavens, would be also two very distant circles, but, when we imagine that we do not properly conceive the immense distance of the fixed stars, this is so great, that these two circles, with respect to our view, coincide, and make only one there; and this is indeed also a natural consequence of what was before observed, that the earth itself is but a point, or thing of no consideration, with respect to the sphere of the heavens.

When astronomers speak of the horizon, however, in general terms, they are always to be supposed to mean the rational horizon, for they keep up to the distinction, and whenever they intend to speak of the sensible horizon, they make the distinction by using that term.

In order to understand the divisions which the secondary circles make in the heavens, it is necessary to understand that made by their primary, or by the horizon. We are to understand then, that a great circle of the sphere, whose plane cuts the point of the surface of the earth on which the observer stands, or a great circle, whose plane passes through the centre of the earth parallel to it, divides the heavens into two hemispheres, which, from their situation and circumstances, are called sometimes the upper and lower hemisphere, and sometimes the visible and invisible hemisphere. The upper, or visible hemisphere, is that half of the heavens which is above the horizon, whether we mean the sensible or the rational horizon, for they are, in effect, the same thing; and the lower, or invisible hemisphere, is that half of the heavens which is below the horizon. All the others in the upper are consequently to be seen by the person whose horizon it is that divides the sphere, and all the stars, that are in the lower hemisphere, are invisible to him. The terms also above the horizon, and below the horizon, are used to express, the first, all those stars which are seen in this place, and the other, all those which are hid, or are in the lower, or invisible hemisphere.

It has been observed, that every part of the earth's surface has a different horizon, and this, as it is evident from observation, is a proof of the earth's being round; for if the earth were a great plane, or flat, the horizon of all places would be the same; but wheresoever the observer stands, that circle which is his horizon, or is the horizon of that place where he stands, being a great circle of the heavens, dividing it into two parts, it divides, in the same manner, every great circle of that sphere which is intersected by it. And as every horizon must have its two poles, which are the point directly over the observer's head, and the point directly under his feet, which are called the zenith and the nadir; these, notwithstanding that they they are different in every place, yet are in every place the two points at which all those circles, which are called azimuths, or verticals, or, according to the term here to be explained, secondary circles of the horizon, do intersect each other.

The great use of these secondary circles, which after what has been said of the horizon, and of their situation, with respect to it, will be perfectly understood, is to measure the altitude of any point of the heaven

above the horizon, or its depreſſion below the horizon, or to give the altitude of any of the heavenly bodies by meaſure, ſince all circles are divided by certain number of degrees ſerving as rules of meaſure. Thus, if we have occaſion to meaſure the altitude of any point in the viſible hemiſphere, we know, that its altitude is the arc of a ſecondary, or vertical circle, or the arc of an azimuth, interſected between that point and the horizon. If, for inſtance, it be required to know what is the height of a ſtar above the horizon, we are to imagine one of theſe ſecondary circles, drawn in the ſphere ſo as to paſs through the ſtar; when this is done, the ſtar and the horizon, when it is cut by that circle, are two points, the diſtance between which, reduced to the meaſure of a circle, gives the height of that ſtar. The arc of that ſecondary circle, between the ſtar and the horizon, is found, by meaſure, to contain ſo many degrees; and ſo many degrees are the altitude of the ſtar. This admeaſurement is made, with great facility, by means of a circle, or part of a circle, divided into three hundred and ſixty degrees, for, if this be ſuſpended in ſuch a manner, that the plane of it is perpendicular to the horizon, or diameter acroſs it, it will repreſent the horizon, and, on turning the circle to that, the plane of it being continued up to the heavens, would paſs through a ſtar, the edge will repreſent a vertical, or ſecondary circle, drawn through the ſtar and the horizon, and conſequently, on placing a ruler, or ſtrait piece of any thing, ſo that the ſtar may be ſeen along it from the centre of the circle, and the number of degrees that are intercepted between the ruler and the diameter, which repreſents the horizon, will ſhew, on the figures marked on the edge, how many degrees that ſtar is above the horizon. Nothing can be ſo familiar as this method of meaſuring, nor can any thing be more certain. Indeed a circle, nor the half a circle, is not neceſſary, for a fourth of one, that is, what is uſually called a quadrant, is enough for all poſſible occaſions, ſeeing that contains ninety degrees, and the ſpace, in which any thing is to be meaſured, contains no more, for the zenith being a fixed point, and the horizon a fixed point, and their diſtance from one another being only ninety degrees, or a quadrant of a circle, there can be nothing to be meaſured but what falls within that height.

The quadrant is, on this principle, the inſtrument of meaſuring the altitudes of the heavenly bodies, and as theſe altitudes are all meaſured upon ſecondary circles, and theſe circles interſect one another at the zenith, which is only ninety degrees above the horizon, a larger quantity of the inſtrument would be only an encumbrance, and this anſwers all poſſible purpoſes. The ſtar, whoſe altitude is to be taken, is to be viewed along the edge of this quadrant, either through plain, or teleſcopic ſights. The plain ſights are only oppoſite holes, pierced in plates of braſs, through which the ſtar is to be ſeen. The teleſcopic ſights are much more accurate and nice, they are made in manner of a teleſcope of the ordinary refracting kind, and, for the greater preciſion, the ſtar is not only expected to be ſeen through this teleſcope, but there are a couple of hairs drawn acroſs the eye-glaſs, ſo as to interſect one another at the centre of it, and the exact admeaſurement is taken when the ſtar is at the point of their croſſing one another. In taking nice obſervations, an inſtrument of a large radius is neceſſary, that the diviſion may be into ſmaller parts. In this caſe, to avoid the encumbrance of an unwieldy inſtrument, they make a ſmaller part of a circle than a quadrant ſerve the purpoſe; for ſince a quadrant is all that can poſſibly be

neceſſary on any occaſion, as ninety degrees is all that is between the horizon and zenith, much leſs than a quadrant is all that can be neceſſary on moſt occaſions, and accordingly they make the inſtrument equal only to a ſixth, or an eighth of a circle; this they call, in the firſt caſe, a ſextant, and, in the other, an octant; and, in conſequence of the ſmaller number of degrees it contains on a limb of that extent, theſe may be divided into a greater number of portions. Thus the ſmaller part of a circle, (the inſtrument contains the greater) is naturally the accuracy of the diviſion.

SECTIONS, *Conic.* Figures made by a plane paſſing through all, or part of the ſides of the cone. The curve line, deſcribed upon the ſurface of the plane by the cone, is a conic ſection. It is eaſy to ſee theſe muſt differ greatly according to the circumſtances; if the plane paſs in a direction perpendicular to the axis of the cone, and cut through all its ſides, the ſection muſt be a circle; if the plane be inclined to the axis, and cut through all the ſides in this direction, the ſection is an ellipſis; if the cone be cut through by a plane, to which one of the ſides of the cone is parallel, the ſection is a parabola; if it be cut through by a plane, to which one of the ſides is inclined, the ſection is an hyperbola. Theſe are the conic ſections referred to by aſtronomers.

SECTION, *Common of two Planes.* The right line in which any two planes, which are not parallel, and are extended, do interſect each other, is called their common ſection. *See* PLANE.

SEDES REGIA. A name for the conſtellation Caſſiopeia; it is one of the old Latin names, and expreſſes the ſeat, inſtead of the perſon ſitting. Caſſiopeia was a queen, and this her throne.

SEMICIRCLE, *the Half of a Circle.* If a ſtrait line be drawn from one part of the circumference of a circle, and continued to the circumference on the oppoſite part, paſſing, in its way, through the centre of the circle, this divides the circle into two halves, theſe halves are called ſemicircles, and the line, which divides the circle into theſe, its diameter. *See* CIRCLE.

SEMIDIAMETER *of a Circle.* Expreſſes a ſtrait line drawn from any part of the circumference of a circle to the centre of the circle, and there ſtopped. This is alſo called a radius of a circle, and it is equal if made from whatever part of the ſame circle. *See* CIRCLE.

SEMO. A name by which ſome, who are fond of uncommon words, call the planet Mercury. It is uſed by ſome of the Latin writers, and ſeems to have been given to the planet becauſe of its being the loweſt, or neareſt to the ſun of all the planets, as the antients had a way of calling the ſubordinate, or lower deities, Dei Semones.

SENGI, *or* AL SENGI. A name by which ſome, who are fond of uncommon words, have called the conſtellation Lyra, or only the great ſtar in that conſtellation, called Lucida Lyræ. It is one of the Arabic names of that conſtellation, and is derived from the Perſian name Ciengle, an harp. From this alſo comes the barbarous word Sangue for the ſame conſtellation, as Alobore for Al Lura.

SENSIBLE HORIZON. A term uſed by aſtronomers by way of diſtinction from the rational. The ſenſible horizon is that circle which is extended every way to the heavens, and has its plane paſſing through the point of the earth's ſurface on which the obſerver ſtands. The rational horizon, on the contrary, has its plane paſſing through, not that ſpot, but the centre of the earth, parallel with the place where the perſon ſtands. The rational horizon is what people principally refer to, who uſe the term horizon ſimply, in aſtronomy.

SEPHINA, *or* Al Sephina. A name by which ſome, who are fond of uncommon words, call the conſtellation Argo, or the Ship; this is one of its Arabic names, and it expreſsly ſignifies a ſhip, and, in the ſame language, it is called Merab, a word which does not ſignify a ſhip, but a coach and a chariot, and we find it alſo called a chariot, or chariot of the ſea, by the Greeks.

SEPTEMTRIONES. It is plain from what we meet with in the oldeſt authors, who have at all treated of aſtronomy, that the Septemtriones were called by the name of the Bear. We may, in ſome degree, collect this from the very name of Arcturus, which is evidently of Greek origin, and is mentioned by Heſiod, and all the old writers, in ſuch a manner, as to confirm this opinion. Homer alludes to the Greeks uſing it for their direction in ſailing; but Heſiod is ſilent as to that particular; perhaps Homer ſpeaks of the knowledge of his own time, not of that he wrote of.

SEPULCHRE, *or the* Holy Sepulchre. A name of one of the northern conſtellations, or of what has been made a conſtellation, by thoſe who are ſo fond of giving Chriſtian names, and Chriſtian forms, to them all. Schickard had gone ſo far as to baniſh the Pagan appellation, Andromeda, out of the catalogues of the ſkies, and to put the ſcripture name of Abigail in the place; but Schiller was not to be ſo contented; he has new modelled the whole conſtellation. The figure which he puts in the place of Andromeda, is that of a ſepulchre, and this the name of it.

SERPENS, *the Serpent*. One of the conſtellations of the northern hemiſphere; it is one of the forty-eight old ones, or thoſe which are mentioned by all the antient aſtronomers, and were delivered from the Egyptians to the Greeks. The Serpent is a conſtellation of conſiderable extent, and comprehends a great many ſtars, and ſeveral of them of conſiderable ſize.

It is repreſented in the ſchemes of the heavens as a ſnake, of enormous length, placed between the legs of Ophiucus, and extending to a great length before and behind him. The body is repreſented not ſtrait, but with a number of convolutions, and there is one twiſt, or circular turn, toward the tail; the head is drawn ſomewhat naturally with hair, and the mouth is open, the head almoſt erect, with reſpect to the greater part of the body.

The conſtellations near the Serpent are Ophiucus, Hercules, Libra, Scorpio, Sagittary, and at a greater diſtance the leg of Bootes, and the Eagle. Ophiucus ſtands acroſs the middle of its body, and has hold of it with each hand; the head of Hercules is very near its head, and the arm, which holds his club, almoſt cloſe to it; a part of its body, at about a fourth of its length from the head, almoſt touches the extremity of the beam of Libra, and the reſt of the body runs,

in ſome meaſure, parallel with Scorpio and Sagittary, being between the legs of Ophiucus; the tip of its tail comes very near one of the wings of the Eagle, and its head is not far from Bootes, coming almoſt cloſe up to the Northern Crown. Many of the animals of the heavens are very bad repreſentations of thoſe on earth, but that is not the caſe with this figure of the Serpent, excepting for the hairyneſs about the head, the figure is very like that of a ſerpent, and its poſture natural, when we ſuppoſe it ſtruggling againſt one, in whoſe hands it is graſped.

The antients counted eighteen ſtars in the Serpent. Hipparchus, who made the firſt catalogue that ever was taken of them, we are told, allowed ſo many, and Ptolemy, his faithful follower in all things, has ſet down the ſame number. Tycho has reduced the number to thirteen, but it has, ſince his time, been raiſed to more than its original ſtandard; Hevelius counted twenty-two ſtars in it, and our accurate and excellent Flamſtead has marked down ſixty-four; of theſe there is not ſo much as one ſtar, either of the firſt or the ſecond magnitude, but thoſe of the third make a very conſpicuous figure in the heavens, and of theſe there are more than in any conſtellation of the ſame extent, the reſt are of ſmaller ſizes, but not, in general, of the ſmalleſt; they are diſtributed very regularly over the body, and indeed a ſerpent was a happy figure for this purpoſe, becauſe it could be turned and wound about ſo as to receive them. There are ſeven or eight conſiderable ones about the head, between that, and the part of the body which touches Ophiucus, there are ſeveral running in a double, and ſometimes in a ſingle line, and the tip of the tail is marked by a bright one. The conſtellation is, upon the whole, as well determined as any in the heavens.

The Serpent may, in ſome degree, be looked upon as a part of the conſtellation Ophiucus, and it is, in general, conſidered as ſuch, being called Serpens Ophiuci, or Serpentarii; ſo that the ſeveral fables, which the Greeks have deviſed for aſcertaining the hiſtory of that conſtellation, are applicable, in the ſame manner, to this; theſe may be ſeen under the head of that conſtellation. In general, ſome have ſuppoſed it to be one of Triptolemus's dragons, which Carnabos killed, and others, the Serpent of the river Segaris, deſtroyed by Hercules. The Greeks have aſcribed its origin to theſe, and ſeveral other exploits of the heroes of their hiſtory, but it is of no relation to any of them. The Serpent is as certainly, as the ſigns of the zodiac, of Egyptian origin, and we know not what they meant by it, any more than by the Goat, and her kids, in the arms of their Auriga.

Serpent, *Crooked.* A name by which the author of the book of Job has mentioned one of the conſtellations, for this is certainly the caſe, although the dullneſs of many commentators, and the obſtinacy of others, to ſay nothing of the ignorance of ſome, who have dared to attempt ſuch an office, have queſtioned it, and given different interpretations to the paſſage. The word are, *Whoſe ſpirit beautified, or ornamented the heavens, and whoſe hand has formed the Crooked Serpent.*

Some of thoſe who have attempted to explain this paſſage, have imagined, that there was no more meant by it, than the Serpent of our fields and hedges; and indeed there might be ſome meaning made out, though many have diſputed it, in this ſenſe, by conſidering it as an expreſſion of the power of God, in creating the greateſt, as well as the leaſt of things; it is he who formed the expanſe

panse of the heavens, and it is he who created the meaneſt reptile of the earth; this, though not hit upon by thoſe who favour the opinion of the word Serpent, being placed, in its literal meaning, might be underſtood as ſuch; and indeed when we conſider the manner, ſo frequent among the Hebrews, of uſing a part for the whole, for no people were ſo fond of that figure, it will ſtand in the fairer footing of credit; but this is but an appearance. The whole paſſage ſhews, that the heavens, and only the heavens, were intended, and that the Serpent is named as an ornament of the heavens; this excludes the reptile of the earth from any ſhare in the conſideration; beſide, the epithet crooked, or tortuous, for that is the exact meaning of the Hebrew, does not abſolutely belong, nor would have been given to, the creature on that occaſion. The Serpent of the earth can twiſt itſelf into many forms at pleaſure; but it is not therefore to be called crooked, becauſe it has a power of making itſelf ſo. Now in the heavens there is a conſtellation which repreſents a ſerpent, and which is crooked, or tortuous, and very particularly ſo, and which, as it always retains that character, may be very properly expreſſed by that epithet.

If we ſuppoſe, that the book of Job was written by Moſes, one might, indeed, wonder to hear a conſtellation ſpoken of ſo early, ſince the earlieſt origin which we pretend of the conſtellations, is much later than his time; but it is idle, nay, it is ignorant, to ſuppoſe this book written by that author; far from finding any ſupport for ſuch a wild opinion, we ſhall, on the ſtricteſt enquiry, find reaſon to believe that book to have been written only about two thouſand three hundred years ago, a time at which we know the Greeks were acquainted with the conſtellations, and conſequently other nations might, nay, and might long have been, for they are not ſpoken of, even by the earlieſt Greeks, as new things, but mentioned as if of very early origin, even in reſpect of them.

The author of the book of Job was not a great deal earlier than ſome of thoſe Greeks who ſpoke moſt freely of the conſtellations, and he might therefore very naturally ſpeak of them: nay, we have proof enough, that he might, becauſe we find he did; and if we could doubt whether he meant this name, the Crooked Serpent, as that of a conſtellation, or not, we cannot pretend to diſpute his having meant conſtellations by the Orion and the Pleiades, which he alſo mentions, perhaps by thoſe names which are interpreted Orion and Pleiades: he did not mean what we do by thoſe words; nay, certainly this was not the meaning, but yet certainly he meant conſtellations, and ſuch as were moſt in uſe at that time in the world, and moſt conſulted in agriculture and navigation.

I would make it a point in a treatiſe of aſtronomy, not to have ſuch terms relating to the ſcience, as occur in the ſacred writings, unexplained. We have purſued this matter ſo far then as to find, that the author of this book might mean a conſtellation, ſince he has mentioned other conſtellations, and that he muſt mean ſomething in the heavens, ſince he named the Crooked Serpent as an ornament in the heavens. We find, he was moſt likely to name one of thoſe conſtellations which men moſt regarded, ſince thoſe were moſt underſtood, and were the moſt uſeful. And on examining ſome of the oldeſt writers, we ſhall find a conſtellation under the name of Anguis, and Lucidus Anguis, a ſerpent, and a lucid, or ſhining ſerpent. Now this was doubtedly the Serpent, or Crooked Serpent,

pent, of the facred writer; for thofe who have mentioned it have done fo, in refpect to its being of ufe, in refpect to the hufbandman, and the failor.

It remains only to fettle which of two Serpents that there are in the northern hemifphere, and we fhall have explained the paffage. If the author had meant that of Ophiucus, he would have named the human figure with it, but he has not. There is another conftellation of this figure near the north pole, called Draco; this is a ferpent, and a tortuous ferpent; and there is all the reafon in the world to believe this was meant, becaufe its fituation toward the pole rendered it very ufeful to failors, and all agree, that failors did obferve it.

It muft be confeffed, that Homer and Hefiod, who mention Syrius and Orion, the Hyades, the Pleiades, and fome other of the conftellations, do not mention this of Draco; but we have no reafon to conclude from that there was no fuch conftellation in their time. The Greeks themfelves might allow it a place in the fphere, and yet thefe poets might happen not to name it; but it is not neceffary for juftifying the meaning of it in this paffage, to fuppofe, that the Greeks did know it. We are fenfible, that it might be known to thofe people, among whom the author of the book of Job wrote, although not to the Greeks. We know the Greeks did not invent the conftellations, but received them from the Egyptians, nay, we know they did not receive them all at once, but by degrees, this, therefore, might be among the Egyptians, while the Greeks were ignorant of it; and it might be familiar to the Hebrews before they took it into their fphere.

Upon the whole, that the Crooked Serpent of the book of Job is fomething in the heavens, not any thing upon the earth, is certain, fince it is brought in as an ornament to the heavens. It is moft likely, that the author, on this occafion, would mention a conftellation, the moft familiar among thofe to whom he wrote; and his intent being to exalt the goodnefs, as well as greatnefs of God, he would fix upon one that was ufeful; thefe reafons all lead us to fuppofe, that it was the Dragon of the northern hemifphere, that he meant the Draco, as we call it in our fpheres; and its tortuous figure very well confirms it by the epithet.

Among the many who have miftaken its meaning, fome, who were confcious that it muft be intended to exprefs fomewhat in the heavens, have gueffed that it meant the zodiac, but that is not tortuous, fo the epithet deftroys the opinion; others have imagined, that it meant the Milky Way, or Via Lactea, but this does not by any means reprefent a ferpent, nor was ever underftood to do fo; befide, although its courfe in the heavens is not ftrait, it cannot be called tortuous.

SERPENTARIUS. One of the conftellations of the northern hemifphere, called by the generality of writers, Ophiucus. *See the article* OPHIUCUS.

SESQUIALTERAL RATIO. When of two numbers, the antecedent contains juft once and an half, they are faid to have a fefquialterate ratio. *See* RATIO.

SESQUITERTIAL RATIO. When an antecedent number, or quantity, contains the confequent number, juft once and a third part, they are faid to be in a fefquitertial ratio. *See* RATIO.

SEVEN STARS. A common denomination of the conftellation, called, by aftronomers,

mers, the Pleiades. The hiſtory of that conſtellation, and the diſpoſition of the ſtars of which it conſiſts, have been already given under that article, but there is yet a point to be conſidered with relation to it, which has occaſioned much diſpute. It has been aſſerted by ſome, that the Pleiades conſiſts only of ſix ſtars; and others have affirmed, that this Engliſh name is proper, for that there are ſeven; and, from the various opinions of writers of different times on this ſubject, it has been concluded, but too haſtily, by ſome, that the ſeventh ſtar of this conſtellation was one of thoſe which appear and diſappear at times in the heavens, and which have thence been called, by ſome, new ſtars, and, by others, re-apparent ſtars. Thoſe, that have been called by that name, are truly fixed ſtars, but this ſeventh of the Pleiades is not of the number. The conſtellation does indeed conſiſt of a very great number of ſtars, viſible by the aſſiſtance of teleſcopes, in the place of the original ſix or ſeven. Galileo, ſoon after the invention of teleſcopes, counted thirty-ſix in it, of which he has given the places in his *Nuncius Sidereus*, and afterwards ſpeaks of more than forty, beſide the ſix which are ſeen in common by the naked eye; ſo he expreſſes himſelf, for he adds, that the ſeventh is rarely ſeen. After him, De La Hire, of the French academy, in the memoirs of that body for the year 1693, mentions ſixty-four, which he diſcovered in the courſe of an obſervation of the paſſage of the moon through this conſtellation; and Maraldi, in the memoirs of the ſame body for 1708, has given the places of fifty-ſix of them. But all theſe are wholly inviſible to the naked eye, except the ſix, or the ſeven (whichſoever the number is to be determined) that are uſually ſeen. Thoſe, who fix the certain number to ſix, and make the ſeventh one of the new, or re-apparent ſtars, have gone ſo far as to ſet down ſeveral diſtant periods, at which they thought it did, and ſeveral at which they thought it did not, appear. They aſſert, that it was ſeen ſome time before the ſiege of Troy, after which it diſappeared for a long period, and, at the end of that, became viſible, and has ſince appeared and diſappeared, at times, in the manner of ſome others in the other conſtellations. It is evident, that Homer, Attalus, and Geminus, mention only ſix, and that Simonides makes them ſeven, as do alſo Varro, Pliny, Aratus, and, what is of much more conſequence, Hipparchus and Ptolemy. But we are not to ſuppoſe, for this reaſon, that the ſeventh ſtar appeared in the times of the latter of theſe, or diſappeared in thoſe of the former. If we were to call all thoſe re-appearent ſtars which ſome of the antients have ſeen, and others not mentioned, we ſhould greatly ſwell the liſt of thoſe ſtars. The ſeventh of the Pleiades is, at all times, equally viſible, but it is ſo much ſmaller than the others, that it is not every eye can diſcern it. Some people, whoſe ſight is better than that of the generality of men, can at all times ſee ſeven ſtars in the conſtellation, and theſe would have ſeen ſeven whether they had lived in the days of Homer, or thoſe of Hipparchus; others, whoſe ſight is leſs acute, can ſee only ſix; this is the true ſtate of the caſe; nor is the diſpute, whether the Pleiades conſiſt of ſix, or of ſeven ſtars, for we ſee, that the conſtellation conſiſts of a vaſtly greater number; whether the eye of him who examines them can ſee ſix or ſeven of that number.

SEXTANS, *the Sextant*. One of the new conſtellations of the northern hemiſphere, or of thoſe which Hevelius has formed out of the ſtars not taken into the out-lines of the others, and added to the forty-eight old ones.

It is a ſomewhat large conſtellation, and it contains a quantity of ſtars very well proportioned to the ſpace which it occupies in the heavens, and theſe are very happily diſpoſed according to the lines of the figure. There is, in this reſpect, a great difference with regard to the new conſtellations, not only between that and the old ones, but among one another. The old conſtellations, which were probably formed by the Egyptians, and which we have received from the Greek aſtronomers, were formed in parts of the heavens where there were many ſtars, and ſome among them conſpicuous, and they were contrived to take in the greater part of theſe, and to place the moſt conſiderable in the moſt conſpicuous parts: as in the Bull, for inſtance, one in each eye, and one at the tip of each horn. Among theſe the new ones which have been formed only in the ſpaces left by the antients; among theſe there are many that have been put in places where there are a great number of ſtars, but ſome where there are very few. Thus the Little Lion is covered with ſtars as well as any conſtellation among the old forty-eight, and not one of them all ſtands in a place where there was no occaſion for one.

The Unicorn, on the contrary, has very few, and moſt of thoſe inconſiderable, and, though it is not without its uſe, might much better have been ſpared than the other. The Sextant is one of the more neceſſary conſtellations; it ſtands in a place very thick ſet with ſtars, and they are ſome of them very conſpicuous; it is placed between the feet of the Lion, and the twiſted part of the body of the Hydra. The point, or top of the Sextant, is juſt under the right fore paw of the Lion, and oppoſite to the head of the Hydra, its limb is oppoſite to the Cup, but at a conſiderable diſtance, and one point of its extremity is very cloſe to the back of the Hydra, at ſome diſtance below the turn or twiſt; and the other is near the left hinder leg of the Lion.

The figure is that of the mathematical inſtrument of this name, and it is very well deſigned. Hevelius, who formed the conſtellation, allows it only eleven ſtars, but Flamſtead has diſcovered in it forty-one; a great part of theſe are compriſed within the body of the figure, but there are ſeveral diſpoſed very happily along the out-line of it. There is one at the top, another larger at a ſmall diſtance from that on the limb next to Hydra, and two others toward the bottom of the ſame limb, and there is one near the middle, and one at the bottom of the other, which very well mark its direction; in the ſweep there are four in a cluſter near Hydra, and one at ſome diſtance from the other corner. There is a conſpicuous and bright ſtar near the centre of the inſtrument within, and there are ſeveral others conſpicuous enough in the ſeveral parts. The diſpoſition of the ſtars, and the place of the conſtellation, which is very determinately marked by the bend of the Hydra, make it a conſtellation as eaſy to determine at ſight as any in the hemiſphere.

SEXTILE. A name by the Latin aſtrological writers to one of their aſpects, called Hexagonos by the old Greeks. They expreſs, by this, that aſpect of a planet, with reſpect to ſome one of the conſtellations, with which they ſuppoſe it has an affinity, which happens when they are at ſixty degrees diſtance from one another. This is one of thoſe given diſtances at which they ſuppoſe, that the planet and the conſtellation have mutual radiations one toward the other, and co-operate, as they term it, together. The other four aſpects (for there are five in all) are thoſe of conjunction and oppoſition; in the firſt of which the ſtar and the planet are together, and, in the latter,

latter, at one hundred and eighty degrees diſtance, and the Quadrate and Trine, in the firſt of theſe, they are at ninety degrees diſtance, and, in the other, at one hundred and twenty.

SHAULA, *or* AL SHAULA. A name given by ſome to certain ſtars in the tail of the conſtellation Scorpio. The term is Arabic, and ſignifies Cauda Scorpionis.

SHEIRA AL GHOMISA. A name by which ſome, who are fond of uncommon words, call the conſtellation Canis Minor, the Little Dog; it is one of its Arabic names.

SHELYAK. A name by which ſome, who are fond of hard words, have called, ſometimes, the conſtellation Lyra, and ſometimes only the bright ſtar in that conſtellation called Lucida Lyræ. It is one of the names of that ſtar among the Arabs. We find it in Hugh Beigh's tables of the heavens.

SHENELTO. A name by which ſome people, fond of out-of-the-way terms, have called the conſtellation Virgo. It is the Syriac name for the bright ſtar in the ear of corn in the hand of Virgo, which we call Spica Virginis; but it is uſed alſo ſometimes for the whole conſtellation.

SHEPHERD AND FLOCK. A term that we meet with in ſome of the Engliſh aſtronomers as the name of a conſtellation. It conſiſts of a part of the ſtars which compoſe the antient ſign Cepheus. Thoſe, which make up this new figure, are the bright ſtar in the foot, the bright one between the feet, and the cluſters in the hands. It is of Arabic origin. They call the ſtar in the foot the Shepherd, that between his feet the dog, and thoſe in the hands the ſheep. It is exactly the Arab meaning, for they call the firſt Al Rai Paſtor, the ſecond, or that between the feet, Al Relb Canis, and the cluſters Al Aghuam Pecudes.

SHEVIL TEUNO. A name by which people, who will ſeek for hard words, have called the conſtellation (for ſuch it truly is) commonly known by the name of the Via Lactea, or Milky Way. The expreſſion ſignifies a way of ſtraw. It has for its origin the Egyptian fable, that, when Iſis fled from the giant Typhon, ſhe ſcattered heaps of burning ſtraw behind her to impede his courſe in the purſuit.

SHIBBOLETH. A name by which ſome have called the conſtellation Virgo. The word is Hebrew, and is properly, in that language, uſed to expreſs the bright ſtar in the ear of corn called Spica Virginis; but it is alſo ſometimes uſed at large for the whole conſtellation.

SHIELD, *Sobieſki's.* One of the new conſtellations formed by Hevelius out of the unformed ſtars, and added to the forty-eight old aſteriſms. This contains ſeven ſtars, and they are very happily diſpoſed in the figure.

SHIN. A name by which the Chineſe call the planet Mercury. It is alſo the name of water.

SHIP. One of the old forty-eight conſtellations, called alſo Argo and Navis, and mentioned by all the old aſtronomers; it is placed near the Great Dog. *See the article* NAVIS.

SHIR. A name by which ſome writers, fond of hard words, have called the conſtellation Leo; it is the Perſian name of that

that ſign of the zodiac. *See the article* Leo.

SHIRA, *or* Shiri. A name by which ſome, who are fond of hard words, call the conſtellation Canis, or Canis Major, the Great Dog; it is its Arabic name.

SHIRI AL SHAMIYA. A name which ſome uſed for the conſtellation Canis Minor, or the Little Dog; it is the Arabic name, or one of the Arabic names, of that conſtellation.

SHOR. A name by which ſome call the conſtellation Taurus, the ſecond of the zodiac; it is the Hebrew name of that conſtellation, and ſignifies, in that language, a bull.

SIDES, *of a Cone.* Lines drawn from the point which is the vertex to the circumference of the circle, which is its baſe. Be there ever ſo many of theſe, or from what parts ſoever they are drawn, they are called ſides of the cone. *See the article* Cone.

SIDES, *of a plane Number.* Thoſe numbers, which being multiplied by each other, produce a plane number, are called the ſides of the number ſo produced. Thus, if five be multiplied by three, the product is the plane number fifteen, and the five, and the three, are the two ſides of that number.

SIHOR. A name by which ſome aſtronomers have the Dog-Star; it is originally Egyptian, and is properly a name of the Nile. They worſhipped this ſtar, becauſe at its riſing the Nile began to ſwell.

SIMAK AL AZAL. A name by which ſome have called the great ſtar in the ear of corn in the hand of Virgo, more commonly named Spica Virginis; this is its Arabian name.

SIMAK AL RAMIH. A name given by ſome to a ſtar of the firſt magnitude in Bootes. *See* Bootes.

SIMON, *or* St. Simon. A name given to one of the conſtellations. Schiller, and a ſet of people as enthuſiaſtic as himſelf, will have the conſtellations altered from the Heatheniſh figures, under which they are, at preſent, drawn, and will demoliſh the Pagan fables that belong to them. Thus they have raiſed the twelve apoſtles into the zodiac, and given them the place of the twelve ſigns; and in this plan Capricorn has given his portion of the heavens to St. Simon; but the confuſion that would have attended this was too obvious to ſuffer its obtaining any countenance among the judicious. We gave Schickard leave to call Virgo, the *Virgin Mary*, to make the Lion, not the Nemæan ſavage of that ſpecies, but that of the tribe of Judah; but when enthuſiaſm comes ſo high as to be altering the very form of the conſtellations, it is fit we leave the people, who are actuated by it, to form an aſtronomy for themſelves, and that no one elſe pays any credit to it; this is the caſe with Schiller's ſyſtem entirely. *See* Capricorn.

SIOTHI. A name by which ſome of the old aſtronomers have called the Dog-Star; it is an Egyptian name, and ſignifies holy. The people of that country paid divine honours to this ſtar. Oſiris was the ſun, their Iſis the moon, and by their Siothi they often meant this ſtar: it was alſo a name of Mercury; but this ſtar was called alſo by all his other names.

SIRIUS,

SIRIUS, *the Dog-Star*. This is one of the earlieſt named ſtars in the whole heavens. Heſiod and Homer mentioned only four or five conſtellations, or ſtars, and this is one of them. Sirius and Orion, the Hyades, Pleiades, and Arcturus, are almoſt the whole of the old poetical aſtronomy. The three laſt the Greeks formed of their own obſervation, as appears by the names; the two others were foreign, and they were both Egyptian. Sirius was named from the name of the Nile, one of the names of that river being Siris; and the Egyptians ſeeing that river begin to ſwell at the riſing of this ſtar, paid divine honours to the ſtar, and called it by a name, derived from that of the river, expreſſing the ſtar of the Nile.

SNAKE. A name which ſome of the old Latin writers have given to the conſtellation Draco; and they have generally diſtinguiſhed it by an addition of the epithet lucid, or ſhining, a very expreſſive and proper one; for it is a particularly bright and conſpicuous conſtellation. We find it referred to among thoſe which were regarded by the ſailors and huſbandmen of old time:

Et lucidus anguis
Quam quibus in patriam ventoſa per æquora vectis
Pontus et oſtriferi fauces tentantur Abydi,

are the terms under which Virgil mentions it; and we find a like account in all the others. This alſo is the conſtellation alluded to in the book of Job, and there called by the name of the Crooked Serpent. The Greeks are ſilent about it in their earlieſt writings; but it may be very well known in other nations, at the time when the book of Job was written. *For an account of its ſtars, ſee the article* DRACO.

SOIL JAMANE. A name by which ſome, who are fond of hard words, have called the bright ſtar in the ſtern of Argo; they uſually call it Canopus, and ſometimes Ptolemais. Soail is one of its Perſian names, and is derived from the Arabic name Soheil. The name Jemana ſignifies Arabian, for Jeman is Arabia Fœlix.

SOLID. A ſolid, or, as others more preciſely expreſs it, a ſolid figure, is that magnitude, or quantity, in which we may conſider a threefold extenſion, length, breadth, and thickneſs. Every particle of matter is, according to this definition, a ſolid, it has length, breadth, and thickneſs, and we may enquire how much it has of either of theſe, or what proportion they bear to one another. Among the vaſt variety of figures which ſolids may aſſume, there are certain regular and determinate ones, to which aſtronomers continually refer, thoſe are a ſphere, a cone, a cylinder, and a cube; theſe are deſcribed, in this volume, under their ſeveral heads. When they ſpeak of ſolids they do not always mean that theſe muſt conſiſt of groſs material parts, they often ſpeak of ſpace itſelf, though void of all material particles, under this denomination, and it has this threefold extenſion, which conſtitutes the true and regular definition of a ſolid. Thus when we ſpeak of any part of infinite ſpace, and ſpeak of it as of any determinate large veſſel-figure, it is a ſolid, and it is to be treated as ſuch in our diſquiſitions. The cavity of a cup is a ſolid, and when we name a cone, a cube, or any other of the regular figured ſolids, we need not join the idea of matter with them, for it will be as proper if they be conſidered as conſiſting of pure ſpace.

SOLOMON. A name which Hartſdorf

has given to the conſtellation Cepheus. This author always refers to the Old Teſtament in his new naming of the conſtellations; but Schiller has recourſe to the New; accordingly he makes Cepheus, St. Stephen. *See* CEPHEUS.

SOLOMON's CROWN. A name given to the Corona Auſtralis, or Crown of the ſouthern hemiſphere; this is the name given by Schiller. Hartſdorf calls it David's Crown.

SOLSTICE. A term that is uſed by aſtronomers to expreſs that time when the ſun is at, or about, its greateſt declination, north or ſouth from the equator. There are only two days in the year when the ſun is in the equator, and on thoſe days his diurnal motion, round the earth, is made in the equator: at other times, (for the ſun changes place every day of the year, and is not any two days ſeen in the ſame point of the heavens) its diurnal revolution is performed in a parallel, or to the ſouth of the equator.

The two days on which the ſun's place is in the equator, are the tenth of March, and the twelfth of September; from each of theſe days it continues declining, or moving from the equator, north or ſouth, for three months, and, after the end of that period, begins to make its return, which is performed in three months more. From the tenth of March it declines northward, or is found every day in a new place, which is more and more north of the equator till the eleventh of June, and then is going back till the twelfth of September, and from the twelfth of September it is getting every day into a place more and more ſouth of the equator till the eleventh of December, from which day it begins to return, and is returning till the tenth of March following. The ſeveral circles which the ſun deſcribes by his motion round the earth, when out of the equator, are called parallels, and theſe are more and more diſtant from the equator every day, from the tenth of March to the eleventh of June, and from the twelfth of September to the eleventh of December; on theſe two days they are the moſt diſtant of all, and theſe are therefore called the two tropics, becauſe, being at its utmoſt diſtance, the ſun then begins to return. That which happens on the eleventh of June is, from its ſeaſon, called the ſummer tropic, and that which happens on the eleventh of December is, from its ſeaſon, called the winter tropic, and they are alſo named from their places in the heavens; for the ſummer tropic, or moſt remote parallel from the equator north, which happens in June, paſſing through the ſign Cancer, is called the tropic of Cancer; and the winter tropic, or moſt remote parallel from the equator ſouth, which happens in December, paſſing through the ſign Capricorn, is called the tropic of Capricorn. We call all motions in the heavens made toward the north aſcending, and all that are made toward the ſouth deſcending. Thus, that part of the ſun's declination from the equator, which is made toward the north, is called its going upwards, and its return from it is going downwards again, and therefore the ſign which was placed to mark this tropic by the ancient Egyptians, was Cancer, a crab, a creature that moves obliquely backwards, or deſcends obliquely. And, on the contrary, its declination ſouth being deſcending on the tropic, or moſt diſtant parallel that way, marking the end of its deſcent for that time, and its beginning to return backward, or northward, that is upward to the equator. They figured the ſign which was placed at this part of the ſphere by a goat, an animal that is always aſcending, or climbing the

mountains.

mountains as he feeds; this is the explication of Macrobius, and on this has been founded a long and a very judicious explication of the meaning of all the ſigns by Le Pheche.

Having thus explained what is meant by the parallels and the tropics, it will be eaſy to make the term ſolſtice underſtood, as it is dependant on the idea of thoſe parallels and the tropics. We are to obſerve, that although the ſun does apparently change place continually, and is never ſeen any two days together in the ſame part of the heavens with reſpect to the equator, yet, like the motion of a clock, though the hand continually advances, it is not to be ſeen but by ſome attendance. Thus the change of place of the ſun in the heavens, although it be very ſenſible after ſome weeks, yet, in any one day, is ſo little as not to be perceived, unleſs by the aſſiſtance of the nice forms of aſtronomical obſervations; but even aſtronomers, when they ſpeak of the ſun's riſing or ſetting, to explain the viciſſitudes of night and day, ſpeak of it as in the ſame place for one day, or more.

Now, although at other times the ſun's motion, in any little number of days, is very viſible, and his place, in that time, is ſeen conſiderably altered, becauſe that motion is every day continued, and all the time the ſame way, yet there are two periods in the year in which it ſeems, for ſome days, fixed in the ſame place. Theſe are the two ſolſtices, and they are, at thoſe times, when the ſun is in its remoteſt parallels from the equator, north and ſouth, and is about to return, that is, they are, when the ſun's place is in one or other of the tropics. The name ſignifies a time of the ſun's retaining its place, or ſtanding ſtill, and theſe ſolſtices are therefore about the eleventh day of June and the eleventh day of December, and as the tropics are named from the ſeaſons, ſo are theſe; that of June is called the ſummer ſolſtice, and that of December the winter ſolſtice. In all other places the ſun is, after a few days, ſeen to have changed its place in the heavens, becauſe it has been all thoſe days advancing forward, or backward, the ſame way, but here it is otherwiſe; for, making the obſervation juſt about the time of the coming to the tropics, a part of that motion being in advancing, and a part in returning, there requires a great deal more time to make it perceptible. The ſun, in reality, changes its place, as already obſerved, every day; therefore, any term, that expreſſes its ſtanding ſtill, is, in effect, improper; but it is apparently ſtill, or fixed, as the term expreſſes, when at the tropics. In truth, as ſoon as the ſun is advanced to the equator; from its declination north, it begins its declination ſouth without reſting a moment at the point, and, in the ſame manner, the other way; and ſo alſo, at the moment when it has reached its utmoſt declination north, and is at the tropic of Cancer, it is beginning to return backward to the equator, and ſo when it has reached its utmoſt declination ſouth, and is at the tropic of Capricorn; but the time, which it takes in arriving fully at theſe tropics from a little diſtance, and returning from an equal little diſtance to them, is ſomething, and, in that ſpace of time, it appears to be ſtationary; this time of its appearance is the ſolſtice.

When we ſpeak of the ſun's changing place, and of the ſun's diurnal motion in this place, it is to be underſtood as done in conformity to common cuſtom, and to the ordinary modes of expreſſion. The ſun alſo remains fixed all this time in the centre of the univerſe, and it is the earth that moves, but the effect is the ſame.

SOLTHIS. A name by which ſome of

the old astronomers call the Dog-Star; it is the Egyptian name; the word signifies holy in that language. They paid divine honours to this star.

SOUTH. The horizon is to be considered as a circle intersected in two points by another circle, the meridian, which divides it into two equal halves. The point of this intersection, which is nearest the south pole, is the south point, and its opposite the north. *See* CIRCLES *of the Sphere.*

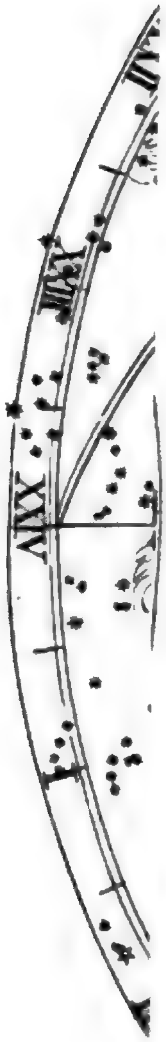
SOUTHERN HEMISPHERE, *of the Earth.* A term used by the geographers, and referred to by the astronomers, expressing that half of the earth's surface which is extended from the equator to the south pole. The meridians divide the surface of the earth each into an eastern and a western hemisphere; and, in the same manner, the equator, or, as it is vulgarly called, the line, divides the earth into two hemispheres, a northern and a southern, each comprehending all of the earth between the equator and that pole.

SPACE, *luminous.* A term used by astronomers to express what has, by some, been called a meteor in the region of our air; but is truly, and is allowed to be by the latest and best writers, the faintest of those appearances which have the fixed stars for their origin. They express by the name of nebulous stars, those bright and lucid little specks in and about some of the constellations, which to the naked eye are white spots, destitute of form or brilliancy; but, by the telescope, are seen to be clusters of little stars; there is one of these in Andromeda, another in the sword of Orion, a third near the head of Sagittary, and a fifth near the foot of Ganymede. Some of these are only distinguishable by the telescope, and the stars, of which they are composed, are scarce perceivable, even by the best assistance which they can give. These are the nebulose stars of authors, which it was necessary to distinguish, because they may be easily confounded with the luminous spaces that are the immediate subject here. These spaces are, however, the next degree below these, the largest and the faintest of all appearances, occasioned by the fixed stars; they are lucid spaces in different parts of the hemisphere, which appear to have nothing solid in them, and which yet retain their situation with respect to the other stars, and therefore must have something belonging to those stars for their origin.

These luminous spaces in the heavens are most frequent toward the south pole. Those, who have crossed the line, and gone far enough to be in the way of making these observations, declare, that, about the pole, they see, in many parts, these lucid spaces, which are large enough, and determinate enough, to be remarkable, as well as sufficiently bright, to be distinguished, and always keeping their place, serve, as well as stars, for making observations. The navigators in these seas were the first that discovered them; the called them clouds, but the determinations of astronomers gave them another character.

These are, doubtless, assemblages of stars, in all respects like to those which constitute what are called nebulous stars; nay, and some of those, which astronomers have described under the name of nebulous stars, undoubtedly belong to this rank, and ought to be numbered amongst them; all the difference is, that those are little clusters of larger, or less remote stars, and these are larger clusters of such as are smaller, or else more remote, for that will answer the same purpose. These being extended to a greater bigness, the

sources


XXIII
XXIV
I

ſources of their light are leſs diſtinguiſhable.

We know that there are many ſtars which cannot be diſtinguiſhed by the naked eye, and that even theſe are of different degrees of bigneſs, or at different ſtages of diſtance, in as much that they are not all diſtinguiſhable by the ſame inſtruments; but, as a teleſcope of moderate power will ſhew ſtars in parts of the heavens where the eye does not diſcover any, ſo thoſe of greater power will diſtinguiſh ſtars alſo in ſpaces were none were to be ſeen by theſe. The heavens are ſtored with them, and, doubtleſs, it is to them, in their different diſpoſition and arrangement, that all theſe appearances are owing: when they ſtand at a diſtance from one another they are to be ſeen diſtinct, and in form of ſtars, and, when in cluſters, they only form luminous ſpaces, in ſome of which particular ſtars are to be ſeen by the aſſiſtance of our moſt powerful inſtruments, and, in others, of which, although none are to be ſeen by the naked eye, yet teleſcopes diſcover them. Theſe lucid appearances differ only in degree, and they are called by theſe names according to that degree; the ſmalleſt are called nebulous ſtars, and the greateſt expanſe of all is the Milky Way. The luminous ſpaces, which are the proper object of conſideration here, are of a middle degree between them; they are wholly of the nature of the Milky Way, only ſmaller, and wholly of the nature of nebulous ſtars, only larger The Milky Way, although it appear, to the naked eye, only as a diffuſed white ſpace, yet, when a teleſcope is directed to any part of it, is found to be a cluſter of innumerable, though of well-fixed, ſtars, whoſe light does not travel down ſingly to us, becauſe of their diſtance, and, perhaps, in ſome degree, becauſe of their being ſo cloſe to one another with reſpect to our view, that it is blended. Courſell, who has given an account of the ſtars of the ſouth pole to the French academy, particulariſes two of theſe luminous ſpaces, and ſays, that they are large, and that they, in all reſpects, reſemble the appearance of the Milky Way in our hemiſphere, only that they are more bright, and more determinate in their form. He added, that they always keep their ſituation, which proves them to be truly owing to fixed ſtars, and in that remote region.

Theſe ſpaces of lucid appearances in the heavens, are not peculiar to the ſouthern hemiſphere, only they are larger there. In conſulting the books of aſtronomers on this ſubject, it will not be eaſy to avoid a confuſion between ſome of them, and in ſome of thoſe which are called nebulous ſtars, and in which no abſolute points of light appear; but it is of the leſs conſequence, as the difference, between all theſe, is, as has been already obſerved, only in degree. We meet with many, who, in reaſoning concerning them, will not allow them to be at all occaſioned by ſtars, or to have any ſtars about them. They ſay, that they are abſolute ſpaces of light, independent of ſuns, or of the ordinary ſources of it, and they call this the light, and, ſomewhat like theſe, the ſources of that light, which, in the Moſaic account of the creation, was prior to the ſun. They urge the non-appearance of ſtars in theſe as a proof, ſince thoſe ſtars, which are the occaſion of the others, do appear, to our teleſcopes, in them; but it is an eaſy anſwer, that thoſe, which compoſe theſe, may be too remote. They farther urge, the irregular figure of theſe luminous ſpaces as a proof that they are not formed by any ſtar in the centre, becauſe its light muſt be diffuſed every way round it, and would make a more regular appearance. But this is objecting to what never was advanced; nobody ever ſup-

posed that any one star occasioned this appearance; and a number of stars may surely be disposed in any figure ever so far from regularity.

Among those, which the advocates for this opinion of their being luminous spaces in the sky, which have nothing to do with stars, have taken, from the account of those reckoned by other writers among the nebulous stars, the most considerable is that in the sword of Orion, it is about the middle of the sword. This has been remarked by Bayer, and by Tycho Brahe and Hevelius, and even by the antient astronomers, for Ptolemy mentions it; they give it the name of a star of the third magnitude. It is indeed of a middle kind between those luminous spaces in which the telescopes discover the stars that form them, and those in which none such are seen, and which are, for that reason, supposed to have none. It is the most singular of all the phœnomena of this kind, for, on examining it with the most powerful telescopes, there are discovered two stars instead of one, which stand within the limits of a luminous space that has no dependance at all on them. Nothing can be a greater proof of these bright spaces absolutely retaining their place in the heavens than this, that these stars are always seen in this, and always in the same situation in it. We do agree with those who assert these spots to be independent of stars, that the two, which are so conspicuous in the confines of this, do not occasion any part of its light, nor indeed do some others that are seen in it; but yet this light is undoubtedly owing to more stars which are yet more remote than these, and whose blended blaze prevents our seeing them distinctly. Huygens, who fell upon this by accident as he was observing some other appearances, calls it a portent, or prodigy, the like to which he had seen no where else among the fixed stars.

Another, which these authors reserve from among the cluster of nebulous stars, is that in the girdle of Andromeda; this is so small that all the old authors have missed it. Hevelius calls it a nebulous star, but these writers assert it to be merely a vacant space enlightened strongly, but with nothing solid in it. In this no star is seen. The next they claim is that in the right foot of Antinous, in which, as in that of Orion, there is something visible, but it is only one star, and not two, as there; they ask of this as of the other, if the light be owing to this star, why is it not more regularly diffused, and why do not other stars, of the same magnitude, also give the same light? The answer is very easy, that no one ever supposed this star did give the light; they are quite independent things as to one another; they happen indeed to be seen together, but that is all. The luminous space is, doubtless, owing to a great cluster of stars very remote, and they happen to fall just behind this star, which, being, with respect to us, placed before them, is seen in the middle of this cluster; just as the two in that of the sword of Orion.

We look upon these little spaces of this luminous appearance, which are visible in our hemisphere, as trivial things, because they occupy but a very small space in the heavens; but that is an ill way of judging things; they may be of an extent equal to the whole system of our sun, including the planet Saturn's distance, and those, who urge for their being independent of any stars, suppose them to be regions of eternal day of that extent. But it is hard to say in what view they would appear if we were nearer to them. They, doubtless, are owing to the blended light of numbers of stars, and, although from the earth these happen to be seen nearly in the same line with one another, there is no saying how immense may be their absolute distance.

SPHARPHARA. A name by which thoſe, who love ſtrange words, call the planet Venus; it is one of the Chaldee names for that planet, and ſignifies conſpicuous.

SPHERE. A ſphere is one of the regularly-ſhaped ſolids: it is alſo called a globe. It is underſtood to be a ſolid of whatſoever materials, in ſhape perfectly round; a ſchool-boy's marble is a ſphere. When we ſpeak of the ſphere of the heavens, we mean that imaginary ſphere, in the concave ſurface of which the ſtars are fixed. The ſun, the moon, and the planets, and fixed ſtars, under the preſent opinion of their being all round ſolid bodies, may be called ſpheres, but cuſtom, which is the law of ſpeaking, has determined otherwiſe: we call theſe globes, and only the imaginary round, in which they are placed, a ſphere. When the geometricians conſider a round ſolid abſtractedly, and the ſeveral lines that may be drawn on it, whether they treat of the convex, or the concave ſurface, are ſaid to write about the ſphere. We thus imagine certain circles to be drawn upon the convex ſurface of the globe of the earth in the concave ſurface of the ſphere of the heavens. Theſe circles are called circles of the ſphere, and the books that treat of them are ſaid to contain the doctrine of the ſphere.

If a ſemicircle be turned round and round on its diameter, till it recover the firſt ſituation, it will have deſcribed, or formed, a ſphere. The original centre of the ſemicircle will be the centre of the ſphere, thus produced by its motion, and any ſtrait line, drawn through the centre of the ſphere, and terminated at each end by its ſurface, will be a diameter of that ſphere. A line drawn from the centre, only to the ſurface one way, is a radius, or a ſemidiameter of the ſphere; and it is plain, that all radius's, and all diameters of equal ſpheres, are equal.

If a ſtrait line be drawn ſo, that, in ſome part, it touches the ſurface of the ſphere, and no where enters its circumference, that line is called a tangent of the ſphere; and any radius of the ſphere, drawn to that point of the ſurface when the line touches it, is perpendicular to the tangent; and any tangent to a great circle of a ſphere, is a tangent to that ſphere. Any ſtrait line which ſtands exactly upright, whether it be on the convex, or concave ſurface of a ſphere, is ſaid to be perpendicular of a ſphere. A line of this ſituation, drawn through the ſphere, would paſs through its centre, and the converſe of this propoſition is equally true, that any line which paſſes through the centre of the ſphere, if continued through it, and extended beyond its convex ſurface, would, in ſuch extended part, be perpendicular to the ſphere.

If the arcs of three great circles be drawn upon the ſurface of a ſphere, in ſuch direction that they meet in three points, they will then form a ſpherical triangle; and the meaſure of a ſpherical angle is the arc of a great circle, deſcribed from the angular point, interrupted between the ſides, and continued to quadrants.

The celeſtial and terreſtial globes, which are uſed in calculations, are ſpheres. The terreſtial is a ſphere, on the convex ſurface of which the earth and ſeas, the mountains and vallies, are repreſented, and the extent and diviſion of kingdoms marked; and beſide this, there are certain circles drawn upon it, to repreſent certain circles, which we imagine drawn upon the real ſurface of the earth, and which ſerve to excellent purpoſes; this is the ſtructure of that uſeful inſtrument called a globe of the earth, or terreſtial ſphere. The celeſtial globe repreſents what we may conceive to be the convex ſurface of what we call the great ſphere of the heavens; this is a repreſentation of what we ſhould, accord-

ing to our own imaginations, see, if placed, without this sphere, at an immense distance in the void of space. We imagine, for our uses in calculation, certain circles to be drawn in the heavens, and these imaginary circles are marked upon the surface of the celestial globe; instead of this, astronomers often use what they call an artificial sphere, which is a machine, having the several imaginary circles, already named, marked by hoops, or rings of brass, and fixed in their place, the rest being left vacant.

If the sphere be put into a circular motion round one of its diameters, this is called the rotation of the sphere, and the diameter round which this motion is made, is called the axis. The two extreme points of this diameter, or axis, where it touches the surface of the sphere, are called the poles of the sphere; in this motion every point of the sphere, excepting the poles, performs a circle, coming round in each revolution to the place where it set out. Any point of this sphere, which is at equal distance from both the poles, forms in its revolution what is called a great circle; to this all the other circles are parallel, and of these every one grows smaller, as the point that describes it by its motion is nearer and nearer to one of the poles. Any circle may be conceived as a great circle drawn upon a sphere, and may be thus understood to have its axis, and its poles. If two great circles of the same sphere intersect one another, they will divide each other into two equal parts; and if a plane be imagined to pass through a sphere, the section of the sphere, that is, the curve which is described upon the plane, by the surface of the sphere passing there, it will be a circle; if this plane pass through the centre of the sphere, the circle will be a great circle of that sphere; if the plane pass through some other part, and not the centre, the circle will be a smaller circle of that sphere, and this will be less, as the place has been nearer one of the poles. A plane that cuts through a sphere, and passes through its centre, divides the sphere into two equal parts, and these are called hemispheres: and a plane that cuts through a sphere, and does not pass through the centre of it, divides it into two unequal parts.

SPICA VIRGINIS. A name given by astronomers to a large star in the ear of corn which is in the left hand of the constellation Virgo; they called also one in her right wing Protingetes.

SPICARUM MANIPULUS. A name by which some, who love uncommon words, have called the constellation Coma Berenices; it is a name found in some of the Latin writers.

SPOTS. Certain appearances of a various form on the surfaces of the *heavenly bodies*, or certain parts, or portions, of their surface, distinguished from the rest by their elevation, or depression, or by the different quantity of light which they reflect. Those of the first and second kind are distinguished by their shadow, those of the last by their brightness or obscurity.

It is probable, that all the heavenly bodies have surfaces varied in this manner; all those which we are able to examine distinctly, apparently have, and they differ in all. The moon, when viewed by the naked eye, is seen to be bright in the greater part of her surface, and in some portions of it dusky, or more obscure; these are the moon's spots. The sun's face, when viewed through a telescope, with the glasses blacked, and the planets in general, when viewed through the same instrument

ment in the usual way, are seen also to have spots like those of the moon, but none of them in so large a quantity, or singly, of such extent. The fixed stars, probably, have their disks, or surfaces varied, as that of the sun, for they are, in all respects else, like that luminary, but they are too remote for the examination, the largest of them appearing so small, even with the assistance of the best telescopes, that we cannot expect to discern any variation on their surfaces. Sirius, or the bright star in the Great Dog, is the largest and finest of all the fixed stars, and this viewed through a five-and-thirty-foot telescope, appears but of about an eleventh part as large as Jupiter, seen by the same instrument. If we allow the disk of Jupiter fifty-two seconds, which we may take as a mean, the largest of all the fixed stars is thus seen but of about five seconds, or not quite so much in diameter. We cannot expect to see spots on so small a surface of so remote an object, and not finding them there, it is in vain to expect them any where among the luminaries of that order.

The spots with which the sun and planets, and even the satellites of the several planets, abound, serve not only to amuse the eye in the observation, but to the most important purposes. It is by the observation of them, that astronomers have been able to prove the revolution of those several bodies round their own axis, and to determine the period of that revolution.

The spots in the sun are numerous, but they are by no means like those of the moon, either in quality, or in quantity; they are not permanent as in that luminary, but are produced occasionally, and destroyed, or, if not so, they appear, and disappear at times, and during the time in which they are observed, appear in continual motion. The spots of the moon are so considerable in size, that they are very obvious to the unassisted sight; those of the sun are so much smaller, that they require to have his disk enlarged to be seen distinctly. We may look upon the sun through a piece of plain glass, black by smoak; but, in this manner, we see the surface uniform. When we view it through a telescope of proper power, with the glasses also blacked, we distinguish a number of spots; they are, in general, small, irregular in figure, and are frequently changing their appearance; they are seen at all times, as in motion, traversing the sun's disk; and there have been many different opinions among astronomers, as to their place and nature. They have been supposed, by some, a kind of planets revolving round this luminary at a very small distance; and others have thought them a kind of exhalations, clouds of condensed smoak, or other light matter, raised to a certain height above the surface of the sun, and revolving round with its motion. Their real revolution considered, with respect to the centre of the sun, is from west to east, but they seem as seen from the earth to move from east to west. As to the supposition of their being planets, clouds, or any other bodies, at all removed from the surface of the sun, and revolving round it, or at any distance with it, it is evident, that they are adherent to its surface, for they appear broadest when at his centre, and gradually become narrower, as they approach his edges. We know the sun to be of a sphercial, or nearly spherical figure, and we know, that a circle, laid on the centre of such a figure, will, if moved toward its edge, all the time touching its surface, appear an ellipsis, and become yet more narrow, as it recedes farther from the centre; it is just thus with the figure of the sun's spots in their motion round it, and we know by the laws of optics, that they are fixed to his surface.

The general ſurface of the ſun appears fiery. Theſe ſpots are of a black colour, perfectly opake, but ſurrounded with an edge of brown. While we purſue their revolutions, we find them alter their real, as well as their apparent magnitude and figure, and we often looſe ſight entirely of thoſe we had in view, and ſee others perfectly new ariſe. They are at ſome times more frequent than others, and, in ſome years, in particular, we ſee the ſun's diſk, for many months, perfectly clear from them, and in others, for as long a continuance of time, obſcured by ſo many of them, that his light muſt be impaired by them; it is about an hundred and forty years ſince they were firſt ſeen. Galileo has a right to the diſcovery; and Schiller, who diſputes it with him, talks of fifty at a time, ſeen on the ſun's diſk in thoſe years; he encreaſes the number, however, by what he calls Fraculæ of the ſun, a kind of ſpots, not darker than the reſt of that luminary, as theſe are but brighter. Many after him purſued this diſtinction of two kinds of ſpots in the ſun, but we ſee nothing that has any right to the diſtinction of the latter kind at preſent. We ſee the ordinary ſpots frequent enough for all the purpoſes of obſervation, and there is ſcarce any thing more entertaining than to have them in their ſeveral changes.

That the ſun is a globe of fire, has been the received opinion from the days of Zeno, and by Pythagoras to the preſent. Some few have excepted againſt, and talked of it, as only compoſed of a ſubtile matter, capable of exciting the ſenſations of light and heat, but this is held in the contempt it ought. There is no doubt of the ſun's being actual fire, nor is it leſs evident, that the general maſs of it is leſs firm, or hard than theſe ſpots. It has been ſuppoſed, that the ſun was again to be like this earth, with mountains on it, and that its general ſurface was covered with melted matter of ſome kind, above the ſurface of which the tops of theſe mountains appeared; and ſome imagined the whole ſurface even, and the matter ſoft, and thought theſe ſpots owing to freſh and crude matter thrown up from below in volcanoes; but it is moſt probable, that the general matter of the ſun is in a ſtate of fuſion, and that amidſt it there are vaſt blacks of ſolid matter incapable of liquefaction; this will perfectly ſolve all the appearances. Theſe ſolid maſſes may be thrown up to the ſurface at times, and at times, and by degrees, ſink down again into the common maſs. They may be thrown up at ſome times in great number, at other times more rarely, and they will be on this place in a continual change of figure, as they are raiſed higher by the motion of the fluid matter, or ſink deeper in its calm and quiet condition, till they are wholly loſt.

However this be, the ſame ſpots are found to return to the ſame part of the ſun's diſk, at the end of twenty-ſeven days, and ſome hours, when we are aſſured of that important point, that the ſun, although it retains at all times its place in the centre of the univerſe, yet has a revolution about his own axis, which is made from weſt to eaſt, and is performed in twenty-ſeven days, and a few hours.

After the ſpots of the ſun, we may examine thoſe of the moon, as in appearance the next of the luminaries in conſideration. If we were to judge from immediate appearances, we ſhould, by the ſpots of the moon, determine, not that, like the ſun, ſhe had a revolution round her own axis, but that ſhe ſtood ſtill in that reſpect; for as the ſpots of the ſun are in continual motion, thoſe of the moon are at all times ſtill, they preſerve their places on her trace, and are liable to no motion that is apparent; if we except that, by which they a little

little approach to the edge of her disk, and a little retreat from it at times, while they preserve the same situation with respect to one another; it is evident, that this is the case, but the conclusion is not just. There requires, to the understanding of this, a farther knowledge. The moon's motion in the heavens is to be understood, and it will then appear, that this immoveable situation of the spots, with respect to us, is a proof, not that the moon has not, but that she has a revolution round about her axis; for otherwise these spots must be seen to move: it is much otherwise with respect to a body, that, relatively to all others, is at rest, as is the case with the sun, and with respect to such a planet as the moon, which is making a continual revolution round this earth, while this earth is carried in a larger orbit round the sun.

It is certain, that the spots of the moon convince us, that the same face of that planet, or the same part of her surface, is always turned to us, although we see a different part of it enlightned, according to the position, with respect to the sun. The little motion in the spots of approaching toward, and receding from the edge, has been supposed owing only to what has been called the librations of the moon, certain tremblings of her globe, such as we should make in a bowl, by changing the centre of gravity; but it has been an effect of superficial knowledge in this science, to conclude from hence, that the moon did not revolve upon her axis. We are to consider, that there is in the moon, as well as in the sun, an axis, which always passes through the same spots, and that at the extremity of this axis are placed two poles, elevated eighty-seven degrees and a half above the plane of the ecliptic, and eighty-two and an half above the plane of the moon's orbit; whence it follows, that the moon's equator, which is ninety degrees distant from each of the poles, and which also passes at all times through the same spots, is enclined two degrees and an half to the ecliptic, and seven degrees and an half to the orbit of the moon.

The poles of the moon are, at all times, in a great circle of the globe of that planet, parallel to the great circle which passes through the poles of her orbit, and through those of the ecliptic, which may be called the colure of the moon, as we express by the name of colure of the solstices, that great circle which passes through the poles of the equinoctial and ecliptic, at the distance of ninety degrees from the intersections of those circles.

Now let us suppose, that the globe of the moon, instead of standing still, as it appears to do, turns round its own axis, like all the other heavenly bodies, the fixed stars themselves, probably, not excepted, and that this revolution is performed from west to east in the space of twenty-seven days and five hours, in a period equal to that of the revolution of the earth about its own axis, which is also performed from west to east, and its return to the same colure in the space of twenty-three hours, and fifty-six minutes; this will serve to explain the varieties of the apparent libration of the moon.

We are to observe, that the globe of the moon, its poles, which are two degrees and an half distant from those of the ecliptic, and which, according to this plan, are always placed on a great circle, parallel to that which passes through the poles of the orbit, and the ecliptic, must appear to move about the poles of the ecliptic, in describing the two polar circles, which will be distant only two degrees and an half, and to perform their revolutions

volutions in a ſpace of time, equal to eighteen years, and ſeven months, from eaſt to weſt, in the ſame time, and in the ſame direction with the nodes of the moon; this will be in the ſame manner as in the Copernican hypotheſis. The poles of the earth perform their revolutions about the poles of the ecliptic, from eaſt to weſt, according to two circles, which are twenty-three degrees and an half diſtant from the poles, in a period of twenty-five thouſand years, which is what cauſes the appearance of the proper motion of the fixed ſtars about the poles of the ecliptic in the ſame ſpace of time.

The poles of the orbit, repreſented on the globe of the moon, ought always to appear upon the circumference of her diſk; for the centre of the moon being upon its orbit, its globe is ſeparated into two equal parts by the plane of that orbit. This forms a circular ſection, which, being viewed from the earth, placed in the ſame place, muſt appear in form of a diameter of a right line, according to the laws of optics, and this right line, or diameter, will paſs through the other moon's centre. The poles of the moon, which are at the diſtance of ninety degrees from all the planets of this circular ſection, which repreſent the orbit, muſt be found on the circumference of its diſk.

Now, while the poles of the moon's globe make their revolution from weſt to eaſt, the colure of the moon, on which the poles are placed, and which is repreſented by a right line, when that planet is at the diſtance of ninety degrees from its nodes, turns in the ſame direction, and transforms itſelf into an ellipſis, the breadth of which continually encreaſes till the moon, being arrived at her node, it conforms itſelf to her oriental edge; and as this colure, which is fixed on the ſurface of the moon, paſſes, at all times, through the ſame ſpots, it follows, that, if the moon had not any motion of revolution round her own axis, we ſhould ſee thoſe ſpots paſs ſufficiently from the weſtern edge of the moon to the eaſtern, and return again afterwards to the ſame place, after that the moon had returned to her nodes. This is not the caſe, and therefore the moon muſt have ſuch a revolution about her axis as was at firſt mentioned in this ſyſtem, and it muſt be performed in the time mentioned, namely, in twenty-ſeven days and nine hours.

To explain the appearance of the ſame ſpots in the ſame places at all times to us, we muſt conclude, that the globe of the moon turns round its poles with an equal and uniform motion from weſt to eaſt, which, being ſeen from the earth, will appear to be, from weſt to eaſt, contrarywiſe to the apparent movement of its colure. This contrary motion cannot hinder but that the ſpots, which are near the poles of the moon, where the parallels, which they deſcribe, are very ſmall, be always carried, by the colure, toward the eaſt, in ſuch a manner, that the motion of the ſpots about the axis, which are made apparently toward the weſt, cannot compenſate the contrary motions; but they will ſerve to modify their ſpeed, ſometimes encreaſing, ſometimes leſſening it. This compenſation muſt always be juſt, except when it ſhall happen that the ſame arc of a parallel ſhall make equal angles with the pole of the moon, and the pole of its orbit, which is a thing very rare, and, when it does happen, varies in an inſtant. This is the reaſon why this ſole cauſe produces many librations as well in longitude as in latitude.

The ſpots of the ſun are ſmall in proportion to his diſk, and they are not permanent. This naturally reſults from their being nothing more than maſſes of a harder matter,

occaſionally

occasionally and accidentally throwing up, by the motion of the general fluid, or melted matter, of which that luminary consists; but it is otherwise with regard to the spots of the moon and planets; we understand the one a body of fire in motion, the others to be globes of earth, and seen like this earth which we inhabit. The sun and fixed stars have the source of their own light in themselves, and therefore any change of colour in the parts, is owing to their being less fiery than the others, but the moon and planets are not luminous in themselves: the light, which they have, is from the sun, and is reflected to us. Now, as some substances will absorb more than others, some reflect less of the light which they receive than others, and consequently those, which absorb most, will appear most dusky; and those, which reflect most, will appear to us most bright.

If we suppose the earth, viewed from a vast distance, as from the orbit of the moon, or some of the planets, we shall easily conceive that it would not appear an uniform globe, but would be distinguished with brighter and darker spaces from the variety of sea and land; and some of these parts would appear very bright from their reflecting almost all the light which they received from the sun, while others of them would appear obscure, because they absorbed a great deal of it, and consequently reflected less than the others. As it would be with respect to the earth seen from the moon, or one of the planets, so it is, according to their different distances, with the moon and the planets as seen from the earth; whether they are made of absolute earth and water, such as those which compose this globe, may be a doubt, probably they are not; they are, however, composed of parts, which absorb, or reflect the light in different degrees, and that it is wholly owing to the appearance of spots upon them. On the moon, which is near to us, these are seen with the naked eye, and very much resemble the disposition of land and seas on the globe of our earth; in the planets, which are more remote, we can only see this by the telescope, and then not so distinctly.

As we see a great number of spots in the moon with the naked eye, we distinguish many more with the telescope; and those, which are seen without this assistance, are distinguished so much more plainly and perfectly in this, that it is the best way of examining it, and we shall speak of the spots here as so examined. We are to chuse the quarters of the moon for the observation. Many people only view the full moon, and wonder that they cannot see what astronomers describe in her. The moon, at full, is a fine sight, and there is a great deal of difference of brightness in the several parts, but all that can be then distinguished, are, (to use the common terms, the land and seas of the moon) known by those degrees of brightness, and of obscurity. The sun shining full upon the moon's disk, exposed to us at this time, all shadows are obliterated, so that nothing of what astronomers speak of the inequalities of her surface, is seen. There are, indeed, some spots, such as those distinguished by the name of Tycho and of Kepler, that seem elevations at this time by their peculiar brightness, but, as the distinguishing character of elevations afterward, it is probable they are not such, but only parts of the sun's surface brighter than ordinary, perhaps of plains, not of sand, as with us, but of marble.

We are to view the moon in her encrease and decrease to understand her spots properly; we there distinguish, beside the land and sea, as they are called, mountains and rocks, elevated a great height above the rest of the surface,

face, and casting shadows from the sun; these shadows are of a pyramidical figure, and usually terminate in a point. Beside these mountains, we see caverns, vast, deep, and empty. These have the part, nearest to the sun, dark, and that, farthest from him, enlightened, as we see in a bason, or other empty hollow body, placed at a distance before a candle. Some of these are very large, and, in many of them, which are less deep than the others, there rises up a little mountain in the middle.

It is certain, that the structure of the moon is thus irregular; there are plains, and there are elevations of vast extent; there are also vast spaces called seas; there are parts very compact according to the reflection, and others so rare and light, that they absorb a vast quantity of the rays; there are elevations of various heights and figure; and there are caverns, some empty, and, so far as we can see, bottomless, and others are shallower, and have mountains in the centre. Whether those spots, called seas, be truly such, is much to be doubted; it should rather seem that there is no water in the moon; any loose earth, or any covering like that of forests over great tracts, would absorb the light so as to make them appear dusky to us; and, as to water, if there were any, the sun having an effect upon it (such as it has on the watery part of this globe) there must be exhalations, vapours, clouds, and an atmosphere; and there is neither one nor the other of these. If there were clouds, we should see the spots sometimes more, and sometimes less distinctly, as they were before them, or, as all was clear. If there were an atmosphere, the forms of the stars must be altered as they went behind the moon, or came from behind her; but nothing of this kind is seen, and, in consequence, there is no atmosphere. What, therefore, these more obscure parts of the moon's disk, usually called seas, truly are, is yet to be determined, and, perhaps, although there is more appearance in favour of the opinion, those dark parts of the planets are not truly seas, although so called. It is necessary, however, to speak of things under their usual names.

That the bodies of the planets have all of them spots of the same nature with those of the moon, is highly probable, but there are two of them on which we have not opportunities of determining certainly; whether it be so or not, these are the most remote from the sun in our system, and the nearest Saturn and Mercury. The great distance of Saturn prevents our obtaining so distinct a view of his disk as we have of the other planets in general; and, to this time, there has been no spot or variation discovered on him. His globe appears of one uniform dead white. Nor is there any more truth in the opinion of his having belts; some have talked of two, others of more, but the three famous ones, seen from many parts of Europe in the year 1719, perfectly explain the nature of that error. The ring of Saturn, at this time, was in that situation, with respect to us, in which it disappears; it is very narrow in proportion to its breadth, and, when the edge is toward us, does not reflect light enough to make it distinguishable at this distance. The planet appeared round, and of the three famous belts seen on it, which were then but very obscure, the middle one was discovered to be the shadow cast by the ring upon the disk of the planet; and the two others were found, by certain computations, to be formed of clouds, or something of that nature, supported in the atmosphere of the planet, and at an equal distance from his body with the ring. Saturn, therefore, to this time, has not been found to have a single spot visible on his surface adhering to it, or being any part of his body.

As

As it is owing to the diſtance of Saturn from the earth, that we cannot diſtinguiſh any ſpots on his ſurface, the ſame defect, with regard to our obſervations, happens in Mercury, from the nearneſs of that planet to the ſun. It is indeed ſo near, that it is uſually hidden by the rays of that luminary, ſo that the obſervations, poſſible to be made on it, are few, and we are in a part of the world the leaſt favourable for the making of them. In theſe northern climates he is leſs elevated above the horizon, at any time, than in the more ſouthern, and what joins in the diſadvantage to us is, that the air here is leſs clear. Partly from one of theſe cauſes, and partly from the other, we ſcarce ever ſee Mercury at all diſtinctly; the remains of the ſun's light ſometimes prevents us, and, at the beſt, as we can only view him ſo near the horizon, the vapours, through which we ſee him, are ſo groſs, that we can ſee nothing diſtinctly. All we know of this planet is, that, by his paſſages over the ſun's diſk, in which he, at ſome times, appears quite ſpherical, and, at others, a little oval, his figure is round, or nearly ſo, and that, according to his ſituation with regard to the ſun, we ſee him, as we do Venus, in form of a half moon, or creſcent: ſpots have not been ſeen on him any more than on Saturn; but with the other planets it is otherwiſe.

The diſk of Jupiter, when viewed through a proper teleſcope, is ſeen not only diverſified more or leſs by his belts, (the nature of which has been already explained in its place) but diverſified with ſpots. But theſe differ, in many reſpects, from thoſe which we ſee on the moon; they are not, in general, parts more obſcure than the reſt of the ſurface of the planet, but brighter. In this they differ both from the greater part of thoſe ſeen in the moon, and from all thoſe of the ſun; and they are not fixed and permanent like thoſe of the moon, but ſubject to alteration in the manner of thoſe of the ſun; they appear at certain times, and diſappear at others, and, during the time of their appearance, which is often many months, ſometimes ſeveral years. They are frequently changing their ſhape and magnitude, a large ſpot often dividing into ſeveral ſmaller, or ſeveral ſmall ſpots combining to form a ſingle large one. They, in this, alſo agree with the ſpots of the ſun, that, after all their variety of form, they will re-appear in the ſame places, and nearly of the ſame ſizes and figures, after ſeveral years entire diſappearance. We ſuppoſe this change of form, and this temporary appearance in the ſpots of the ſun, owing to their being maſſes of ſolid matter, raiſed, at times, above the ſurface of the melted maſs. But a very different origin muſt be ſought for thoſe of Jupiter, and a different ſyſtem to explain their appearances; Jupiter is a globe of cold and quiet matter, not a maſs of liquid fire, as we conceive the ſun to be. Theſe ſpots are land in all probability, and the belts, and ſome other parts of the planet near to them, are underſtood to be ſeas. Some of theſe ſpots appear between the ſeveral belts, but the moſt conſpicuous are abſolutely in them; they ſeem iſlands in thoſe ſeas, and are quite overwhelmed and covered, ſo as to become inviſible, when the ſwelling of thoſe ſtars is greateſt. At other times they appear in lucid ſpecks upon their ſurface; and theſe may eaſily be underſtood to owe all their changes to thoſe ſeas in which they ſtand ſwelling or ſinking. When the water is moſt about them, we ſee them ſmall; as it ebbs, or becomes lower, we diſtinguiſh more of them; they are ſeen larger, and they, in ſome meaſure, alter form. A ſingle ſpot may be divided into ſeveral by the waters riſing, ſo as to make its way into the lower parts of its ſurface,

ſurface, and many may be joined into one by a ſea that once covered the lower parts between them, deſerting them. Thus may they all, by degrees, change their figure, and diſappear, and, after that, be ſeen again in the ſame places nearly; as the water, or whatſoever fluid it be, that covers a part of the ſurface of this planet, is more or leſs plentiful in the ſame place. We ſee how conſiderable a change the flowing and ebbing of the tides of our ſeas will make in certain places. The ſeas of ſo vaſtly larger a globe as that of Jupiter, which is near nine hundred times as great as that of the earth, may be proportionably larger; and, as we attribute the courſe of our tides to the moon, that planet having four moons about him, there may be vaſtly more variety in their courſe, and all the leſſer, if not the greater, changes in theſe ſpots, may be owing to them. It is near one hundred years ſince certain of the moſt conſiderable of Jupiter's ſpots have been remarked with great accuracy, and, in the courſe of that time, it appears, by the obſervations of the ſucceeding aſtronomers, and by our own obſervations, that theſe ſpots have, from time to time, after being buried under the level of the ſeas in that planet, appeared again, many times, in the ſame places, although at irregular intervals, ſometimes after three, ſometimes after five, ſometimes after eight, and ſometimes after eleven years.

The ſame reaſons, which ſhew the imaginary belts of Saturn not to be truly adherent to the globe of that planet, or any part of its ſurface, ſhew that the belts of Jupiter, and they ſhew alſo, that theſe ſpots, are adherent to that planet, and make a great part of his ſurface; we perceive them to move over the diſk of the planet as thoſe of the ſun do, and, like to thoſe of the ſun, they appear largeſt when near the centre of the diſk, and ſmaller, or narrower, as they recede from it; ſo that many of them, and thoſe of conſiderable ſize too, are quite loſt before they reach the edge. The motion of theſe ſpots appears alſo ſwifter as they are near the centre of the planet, and ſlower as they approach its edges, which is another proof that they are adherent to his ſurface. Theſe ſpots all traverſe the diſk of the planet moving from eaſt to weſt.

From this we know, that, as they are fixed upon the ſurface of the planet, they can only move in conſequence of its motion, and we diſcover that the planet moves round its axis from weſt to eaſt. We ſee alſo the ſame ſpot return to the ſame place on the diſk after a little leſs than ten hours, whence we collect the period of that revolution. We find by this, that the immenſe globe of Jupiter makes a revolution about its own axis in nine hours and fifty-ſix minutes, a motion more rapid than that of any other of the heavenly bodies.

Mars is not ſo eaſy of obſervation as Jupiter, becauſe there are only certain times at which he can be ſeen to advantage; but when he is viewed at theſe times, and with teleſcopes of the due power, his ſurface is ſeen much more ſpotted than that of Jupiter; he has often as many ſpots as the moon, and they are proportionably as large; theſe are alſo, like thoſe of the moon, of two kinds, ſome obſcure and dark in compariſon with the reſt of the diſk of the planet, and others much brighter than any other part of the ſurface; they change their figure alſo in the manner of thoſe on Jupiter, and palpably, for the ſame reaſons, ſome of them are portions of land in the midſt of ſeas, and others are ſeas making their way among land. As theſe, therefore, ebb or flow, or are filled or emptied, in the manner of thoſe of Jupiter, they will not only of themſelves exhibit the appearance of duſky ſpots of greater or leſſer diameter, but they will make a diverſity of appearances

in

in the others. The ſpecks of land, ariſing out of them, being ſeen at ſome times, and hid at others, and, when ſeen, being ſometimes larger and ſometimes ſmaller, and altering their ſhape and appearance in every reſpect accordingly.

We meet with accounts of oblong and obſcure ſpots near the centre of the planet, theſe are the ſeparated portions of his principal ſea, for Mars has a ſea of this kind quite ſurrounding his globe in form of a belt, in the manner of thoſe of Jupiter, but it is interrupted in ſome places, and ſo faint in others, that it is not eaſy to trace it entire. At ſome times the ſpots on this planet are more permanent than at others; the dark ones, though they cannot ſo well terminate at the edges as the others, are the moſt conſtant; the bright ones change not only from the time of one obſervation to that of another, but often in the courſe of ten or twelve days. There are, however, enough of them ſufficiently ſteady for the aſcertaining thoſe very material points in the theory of the planet which depend upon them. There is more diverſity in the figures of the ſpots of Mars, than in thoſe of all the other planets.

It has been already obſerved, that there are only certain times favourable for obſerving Mars; this depends upon his different place in his orbit. Mars, being the planet which revolves round about the ſun next above the earth, is, at ſome times, nearer to the earth than at others. This diverſity of his approach is much greater in proportion than that of any planet, and, in conſequence of it, the planet, in the different ſituations, appears, as it were, two diſtinct ſtars. We ſee him in the heavens, at ſome times, faint and very ſmall, and reddiſh in the colour of his light; at others, he appears larger, brighter, and paler, and, when ſeen by the teleſcope, the difference is not leſs, for, in ſome parts of his orbit, he appears ſmall, and his ſpots are ſcarce at all to be ſeen, and in others he is large, and they are very diſtinct. His oppoſitions to the ſun are the times when he is neareſt to the earth, and the difference in this reſpect is ſo great, that he is, in ſome of theſe oppoſitions, ſeven times nearer to us than in ſome of his conjunctions. His body appears of an oval figure from the time of his conjunctions to the firſt quadrature, at which time he appears as the moon three days from the full. From this period of the firſt quadrature to his oppoſition, his diſk fills up, from the oppoſition to the ſecond quadrature he is again in the decreaſe, and, from the ſecond to the conjunction, round. The time for the obſervation of the ſpots is from the firſt quadrature to the ſecond; for, in this time, he goes through his oppoſition to the ſun, and is then neareſt of all to the earth. At this time the diſk of the planet is ſo large, and the light ſo bright, that the ſpots are eaſily, as well as diſtinctly, ſeen, and, as they may be perfectly diſtinguiſhed from one another, it is eaſy to fix upon ſuch as are moſt particular in their form and appearance for obſervation. If we fix upon any remarkable ſpot at this time, we ſhall find that it traverſes the diſk of the planet from eaſt to weſt. This proves, that the body of the planet revolves round its own axis from weſt, and, if we remark the time of one of theſe ſpots returning to its place, we ſhall find this happens at the end of twenty-four hours and thirty minutes. We find, therefore, that the planet turns about on its own axis in this time.

It is about ninety years ago that this was determined, but at firſt it was liable to ſome confuſion and exception. It requires time to repeat the obſervations of this kind neceſſary for the eſtabliſhing a ſyſtem. It was no ſecret that a French aſtronomer at Bologna was making

making obſervations for this purpoſe, and ſome Italian aſtronomers at Raine ſtole the thought, and endeavoured to anticipate his diſcovery. But theſe things do not ſucceed well when they are hurried. The Italians gave the time of Mars's revolution to be thirteen hours. The original author of the experiments fixed it at four and twenty, and forty minutes. This was nearly the double of the time they allowed, and he ſhewed very plainly, that the miſtake, on their part, was owing to their having confounded the two oppoſite hemiſpheres of Mars, on which there are ſpots, in ſome degree, alike. The complete revolution is performed in the time he laid down; but, in this, we do not conſider the mean revolution of the planet, but that which is ſeen when he is oppoſite to the ſun, which is the leaſt of all.

Venus has alſo ſpots in great number, and of conſiderable ſize, and in this, as well as in ſeveral phaſes of the creſcent, the half-moon, and the like, ſhe vaſtly reſembles that planet; but, as it is neceſſary to chuſe certain particular times for the obſerving of Mars, in order to ſee his ſpots to advantage, it is equally ſo with reſpect to Venus, and thoſe times are not ſo eaſily choſen, what might naturally appear the moſt proper not being ſo. In obſervations of Venus, in general, there are ſeen ſpots in abundance upon her, and they are of great extent; they do indeed, like thoſe of the full-moon ſeen by the naked eye, cover a great part of her ſurface, but they are faint, and well terminated at the edges, and are, by no means, proper to determine any thing.

It would be natural to prefer, with reſpect to Venus, as we have recommended with regard to Mars, thoſe times for obſervation, at which the planet was neareſt to the earth; but theſe are not the beſt. It has been already obſerved, that we can ſee nothing diſtinctly on the globe of Mercury, becauſe he is always ſo near the horizon, that we can only view him through the groſs vapours of the earth. This is alſo the caſe with reſpect to Venus, when ſhe is neareſt to the earth; ſhe is, at that time, ſo little elevated above the horizon, that we ſee her twinkling and trembling through thoſe vapours, and could determine nothing diſtinctly about her; all her parts appear confuſed, and though ſpots may be traced, none can be fixed with any certainty. When we have opportunity of ſeeing her out of the reach of theſe vapours, it is only for a little interval, and we want time for obſervations of this kind. We may, at theſe moments, ſee ſpots more diſtinctly, but there is no opportunity to examine their different ſituation, and, added to all this, it is only a ſmall part of Venus that is enlightened at theſe times, and that near her edge, which is therefore the neareſt part, for ſeeing the motion.

We are to ſelect thoſe times for the obſervation of Venus, when ſhe is moderately diſtant from the earth; ſhe will be ſeen, at this time, more enlightened, or will ſhew a larger part of the enlightened hemiſphere, and will alſo be out of the reach of that miſrepreſentation from vapours of the earth by being ſufficiently elevated above the horizon.

When we have ſelected ſuch a time for the obſervation, we are to apply to teleſcopes of conſiderable power, and in the moſt fair and favourable evenings to remark ſome ſpot which is of a very peculiar figure, is ſufficiently bright, and well terminated at the edges, and is near the centre of the planet's diſk. All theſe cautions are neceſſary for the obſervation of the ſpots of Venus, in order to determine any thing from them. It is true that this planet, at almoſt any time, affords a pleaſing ſpectacle through the teleſcope, her creſcent form, and her ſilvery brightneſs, are

very

very pleasing; and spots, such as they are, may be always seen on her; but to distinguish, with a sufficient accuracy, for use, in calculation, is much more difficult. Our climate is, indeed, so favourable, that there are but few opportunities; and notwithstanding the excellence of our instruments, and the skill of those who used them, the best and most determinate observations have been made in Italy; nay, although the climate of France be more favourable by much than ours, yet, when, on occasion of certain disputes with regard to the period of Venus's revolution, it was judged necessary to repeat at the observatory at Paris, and with the best instruments there, those observations which had been before made at Bologna, and at Rome, the spots, which had been the subjects of them, were not to be seen with a degree of precision, in any degree comparable to that in which they are set down, by either the one, or the other of those observers.

We are to undertake the observations of Venus in this country, as liable to all these deficiencies, but yet we shall not want opportunities of seeing all that is necessary, if we use the proper regulations. We shall distinguish on the surface of the planet, when we have taken such an opportunity as is proposed, certain large tracts of a more obscure, and others of a more bright hue than the rest of the planets. The first of these we shall call seas, according to the received distinction, and they have, indeed, more the appearance of seas, than those of any other of the planets, being spread about the surface of the globe, in some measure, as those of our earth; these are large, the brighter parts are small, many of them are amidst the part called land in the planet, and are very fair, but the most conspicuous are those which rise out of the surface of the stars, or the lucid specks of peculiar figure that appear among the dark ones.

If we fix upon one of these spots near to the centre of the planet, we shall find, that it returns to its place after twenty-three hours and twenty minutes. We find thus, that the planet Venus has, like all the others, a revolution about her own axis, which she performs in a period nearly the same with that of the earth, and not very different from that which Mars takes to perform his. There have been objections raised against this system indeed; nor is it a wonder that there should, when the appearances, on which it is founded, are so difficult to be seen, and the observations so liable to error. Bianchini made some observations at Rome, and inferred from them, that this planet's revolution was not performed in between twenty-three and twenty-four hours, but took up twenty-four days and eight hours; this at first sight contradicted reason, and the uniformity of nature, in making this planet so vastly different in its period of revolution about its own axis from the sun, which were nearest to it in their orbits; but although this astronomer had his followers at that time, it has been since abundantly proved, that his observations were too few, and too much interrupted, to form a regular system; and that, throughout the whole, in spite of their appearance, in favour of the long period he established upon them, they do as fully tend to confirm the doctrine of that revolution of twenty-three hours and twenty minutes, which is certainly the truth.

We have seen that the sun is certainly subject to spots on his surface, the fixed stars, probably, also; and that all the primary planets, which we have opportunities of observing, with a sufficient accuracy, afford them. There yet remains another order of the heavenly

venly bodies to be examined, the ſatellites of the larger planets. Thoſe ſecondary planets which revolve round about the others, while they perform their courſe about the ſun; theſe are ſo far as, yet known, only ten in number, five revolving round about Saturn, four about Jupiter, and one about our earth. We ſee that our moon has ſpots in very great abundance, and as the offices of the other nine are the ſame with hers, it is probable they are compoſed of like materials, and reaſon pleads for the belief of their being alſo ſpotted, but this is not all. Experience and obſervation, although they do not prove it, join in ſome degree of confirmation.

In objects ſo remote, and, at the ſame time, ſo ſmall, as the ſatellites of theſe two planets, we are not to ſuppoſe the beſt inſtruments can enlarge the diſk, ſo as to ſhew variations of colour on it; but we ſee ſuch things, in regard to them, as may lead us to infer, that it is ſo; and as in regard to primary, ſo with theſe, we, at the ſame time, make out their ſpots, and their revolutions about their axis.

We are to conſider, that the exiſtence of a great quantity of ſpots on theſe remote and little ſtars, could only ſerve to diminiſh their apparent magnitude, not to be diſtinctly ſeen on them. In an examination of the ſatellites of Jupiter, we ſee them, at different times, appear of different magnitude; they are quite inviſible to the naked eye, but a teleſcope, of ſmall power, will diſcover them; they may be ſeen by a refracting teleſcope of about four feet, but they then appear only as ſtars of the ſixth or ſeventh magnitude to the naked eye. When we uſe glaſſes of more power, we diſtinguiſh their relative magnitude to one another, but this is not always the ſame. We ſee the ſame ſatellite, even when it is at the ſame diſtance from the planet, much larger at ſometimes than at others; the fourth ſatellite often appears leſs than the other three, but ſometimes it ſeems larger than the two firſt, and the third often appears larger than any of the others, but ſometimes it is only equal to the two firſt.

There is no way of accounting for this, but by ſuppoſing, that the ſatellites have ſpots on ſeveral parts of their ſurfaces, and that they revolve round upon their own axis; for if there be a great quantity of dark ſpots on one hemiſphere, and very few on another, that which has the great number will appear ſmaller than that which has the few; and conſequently, as the revolution of the ſatellite, about its own axis, turns toward us, ſometimes the lighter, and ſometimes the darker hemiſphere, the ſame ſatellite will appear ſometimes larger, and ſometimes ſmaller.

But there is a difference of this kind, yet more apparent among the ſatellites of Saturn. The two firſt of theſe are ſo apparently near the body of the planet, in a part of their revolutions, that we looſe ſight of them for a time; the third being larger, and more diſtant, we ſometimes ſee through the whole courſe of his revolution; and, in general, this alſo is the caſe with the fourth and fifth. The four firſt ſatellites always preſerve the ſame comparative magnitude with reſpect to one another; the fourth always appearing the largeſt; ſo that probably their ſeveral hemiſpheres are ſpotted nearly in an equal manner; and which ever part is turned toward the earth, the ſame, or nearly the ſame, quantity of light is reflected, and conſequently the apparent bigneſs is the ſame; but it is otherwiſe reſpect to the fifth ſatellite; this ſometimes appears larger, nay, conſiderably larger, than the third, but at others it is ſmaller, and continues diminiſhing in bigneſs, from time to time, till it be wholly loſt to the ſight; it continus thus inviſible for ſome conſiderable

ſiderable time, and then appears again in its priſtine ſtate, but that not at once, but by a gradual encreaſe. This is an appearance in the ſatellite, which can be no other way accounted for, than by the ſuppoſition of its having a great quantity of dark ſpots on one of its hemiſpheres. We ſhall then underſtand, that where it preſents to the whole free hemiſphere, it is moſt luminous, and conſequently it appears large; as it revolves about its axis, it will, by degrees, bring more and more of the ſpotted hemiſphere toward the earth; the conſequence of this will be, that as leſs and leſs light is reflected, the ſatellite will appear ſmaller and ſmaller, till having brought the whole ſpotted hemiſphere to be turned toward the earth, there is not light enough reflected to make it ſeen at this diſtance, and, from this condition, it will, by continuing the ſame motion of revolution, by degrees, carry more and more of the ſpotted hemiſphere from the earthwards, and a proportionable quantity of the free hemiſphere will appear; it will thus, by degrees, from being juſt viſible, encreaſe in apparent magnitude till it equal, and, finally, till it exceed the third ſatellite in ſize, at which it will continue till ſome of the ſpotted hemiſphere comes in ſight again.

But this is not all that may be brought in favour of the ſatellites of the larger planets, having thoſe ſpots on their ſurfaces, which ſeem univerſal to the heavenly bodies. When the ſatellites of Saturn paſs but near to the diſk of the planet, they are loſt in its light, and at this diſtance are not diſtinguiſhable; but it is not ſo with regard to thoſe of Jupiter; it is from theſe laſt alone that the preſent proof therefore is expected. The ſame ſatellite, in its paſſing the diſk of Jupiter, is, at ſometimes, much larger in entring, and much longer in departing, than at others; ſometimes this takes up ten minutes, ſometimes it is performed in leſs than ſix minutes, and this can only be owing to the diſk of the ſatellite, having at ſometimes none, or only a few ſpots, and at others a great many, ſo that it appears, at thoſe times, much larger, or ſmaller; beſide, when the ſatellites afford, as proofs of their hairy ſpots on their ſurfaces, from the apparent diminutions of magnitude, we have this farther incident in their appearance to countenance it. It happens, not unfrequently, that they paſs before the body of the planet, or immediately between that and the earth; in this caſe, we ſometimes can trace their paſſage over the diſk of the planet, and at others we cannot, which can be only owing to their exhibiting, at one time, a part of their ſurfaces which have ſpots on them, and, at other times, parts which have none, or have much fewer.

The light of the ſatellites, like that of the planet, originally coming from the ſun, and, being reflected to us from their ſurfaces, it follows, that their light, and that of the planet itſelf, muſt be nearly of the ſame degree of brightneſs; it is ſo in effect, only that at ſometimes, that of the ſatellites is more faint. We, at ſometimes, entirely looſe the appearance of the ſatellite, as ſoon as it is got before the planet, and ſee no more of it till it goes off the diſk; at other times we are able to trace it along all its paſſage, and can diſtinguiſh in the place where we know, by computation, that it muſt, at that time, be a little duſky ſpot; this is darker than the general ſurface of the planet, and is ſmaller than the ſhadow of the ſatellite would be. From the ſize of the ſpot, and the appearance of it only at certain times, it is natural to infer, that when the lighter hemiſphere of the ſatellite appears to be turned towards the earth

at the time of its paſſing before the planet, the light from it, and that from the planet, being very nearly the ſame, it is not diſtinguiſhed, but ſeems blended with the body of the planet; but, on the other hand, when a part of the more ſpotted hemiſphere of the ſatellite happens to be toward us at the time when it paſſes over the planet, there we ſee it in form of a ſpot, becauſe it is, in the general, more duſky than the diſk of the planet; and this ſpot appears not only darker, and more or leſs brighter, or leſs diſtinguiſhable, as more or leſs of the ſpotted part of the ſurface comes into that hemiſphere which is toward us, but the ſpot appears larger as it is more faint, and ſmaller as it is more ſtrong upon the planet. There have not been wanting thoſe, who, while they have allowed a part of the ſurfaces of the ſatellites full of ſpots, and other parts leſs full of them, have conjectured alſo, that theſe ſpots might, occaſionally, appear and diſappear as ſome of thoſe in Jupiter do, and that this might occaſion the diverſity of appearances; but it is much more probable, that it is owing to the different parts of the ſurface exhibited to the earth, as the revolution about their axis determines. This revolution ſeems to be univerſal among the heavenly bodies; and indeed ſpots on their ſurfaces ſeem as univerſal.

SQUARE NUMBER. A ſquare number is the term uſed to expreſs a plane number, or a number which is produced by the multiplication of one number by another, the multiplicand and multiplicator in which are equal. If the units of this number are repreſented by ſo many little ſquares diſpoſed in a rectangle, the ſides of that rectangle will be equal; and, when this is the caſe, the product of the multiplication is called a ſquare number.

For inſtance thus, nine is a ſquare number, becauſe three, being multiplied by three, produce it; and, when this is repreſented in a figure, the ſides being equal, the figure is a ſquare. The ſide of a ſquare number is expreſſed by the term ſquare root, it being the ſum of the multiplicator, or multiplicand, equally. Thus, when the number nine is repreſented by ſo many little ſquares as there are units in it, diſpoſed as mentioned already, any one of the ſides being taken for all four, are alike, and the little ſquares, of which it is compoſed, and which ſtand in the place of units, being counted, they will be found to be three; the number three is therefore the ſquare root of the number nine, which is a plane number, and a ſquare number. Four, in the ſame manner, is the ſquare root of ſixteen, five of twenty-five, and ſo on.

We ſee, by this, that every ſquare number may be ranged or diſpoſed in the form of a ſquare. This being true, the converſe alſo is a propoſition equally true, which is, that every number, which, on reducing its numbers to little ſquares, can be arranged into a ſquare figure, is alſo a ſquare number.

What the teachers of arithmetic call extracting the ſquare root of a number, is the finding if a number propoſed, for this inveſtigation, be a ſquare one, its root is always to be found exactly in round numbers, as, if the root of twenty-five were deſired to be found, twenty-five being a ſquare number, that is, a plane number, produced by the multiplication of a number by itſelf, the root may be found in an even or whole number, for it is five. The twenty-five being diſpoſed in a ſquare, each ſide of that would contain five of thoſe leſſer ſquares, which ſtand for units, and conſequently five is the ſquare root of twenty-five.

If the root of twenty-ſix ſhould have been required inſtead of that of twenty-five, this could

could not have been produced in an even or whole number, feeing the given number twenty-fix is not a fquare number. On marking down this twenty-fix upon paper by thofe little fquares, which, on thefe occafions, ftand for units, there would be found a fquare, each of whofe fides would be five, and at one of its corners a fingle fquare ftanding out, which would be the twenty-fixth. In this cafe, all that can be done, is to take the fquare root of the twenty-five, that is, five, and to add to it a fraction, to denote the proportioned part of the unit, or fingle fquare.

From this expreffion of numbers, by the conjunction of lines, inftead of the ordinary ufe of figures, we come at an analogy which could not otherwife have been difcovered, and which is extremely worthy of our attention. This comparifon of lines and numbers together, fhews us, that a rectangle in geometry is the fame to the lines by which it is generated, as the product in arithmetic is to the numbers from the multiplication whereof it arifes. Thefe mutually bear the fame relation to one another. The fquare of a number is the product of a number multiplied by itfelf, and the fquare of a line is the fquare produced by the multiplication of that line into itfelf. In other words, it is made by the motion of a defcribent carried along a dirigent equal to itfelf.

SQUARE ROOT. Expreffes that number, which, being multiplied by itfelf, produces the number of which the root is required. Thus, if the fquare root of twenty-fix had been required, twenty-fix not being a fquare number, no whole or even number could give its root. In this cafe, all that can be done, is to take the fquare root of the next fquare number, which, in this cafe, is twenty-five, and ufe it with a fraction denoting the proportion to the odd unit.

STANDARD, *Roman*. A name given by Schickard to the Eagle, one of the northern conftellations.

STAR OF REVENGE. A name that is given by the aftrological writers to the planet Saturn; it derived from one of the old Greek names After Nemefios, Stella Nemefis.

STARS, *fixed*. Before the ufe of telefcopes men thought the number of the fixed ftars a fettled thing, and could talk of them familiarly within the compafs of a few thoufands: but fince it appears, that immenfe indeed as they are to the naked eye, they are, by no means, the fame in point of number as feen by different people. It is well known, that fome fee only fix, and fome feven ftars in the Pleiades; nay, Kepler gives us an account of one, who could diftinguifh fourteen there; and the fame author tells us of another, who could count forty in the fhield of Orion. A telefcope of a very moderate power will fhew ten times as many ftars as are to be feen by the naked eye, with its general power, and, as the power of magnifying is encreafed in the inftrument, the number of ftars feen encreafes, till (fo far as we can difcover) it is endlefs. De Rhicta fays, he counted more than two thoufand ftars in the fingle conftellation of Orion, which is, at leaft, twice the number that a good eye can diftinguifh in the whole hemifphere. Galileo had once a defign of marking all the ftars of that conftellation as his beft telefcopes fhewed them to him, but, counting twenty-one in the fingle nebulous ftar, and five hundred in the compafs of about a degree and an half fquare in another part, he gave up the attempt.

The obfervation of Sirius's diameter being five feconds, had, for its author, one of the moft accurate, and moft judicious aftronomers the world has ever known, Caffini, and, whenever

whenever it is repeated with the ſame apparatus, it ſucceeds in the ſame manner, and verified very punctually; and other ſtars have alſo apparent diameters of nearly the ſame extent. This is, however, a point that has been combated very ſtrenuouſly ſince, and ſome of the greateſt of our own aſtronomers have not only taken away ſo great an apparent diameter from this ſtar, but all diameter whatſoever. They aſſert, that all the fixed ſtars are mere lucid points, and adviſe the viewing them, not through an object-glaſs, the aperture of which is limited as in this obſervation, but through one that has been ſmoaked black, and they aſſert, that, thus, neither Sirius, nor any other of them, have any the leaſt meaſurable diameter. In favour of this laſt ſyſtem it is advanced, that, when any of theſe large fixed ſtars immerge behind the dark edge of the moon, they are ſeen to plunge in at once, and, in the ſame manner, burſt out at once again in an inſtant in their full ſplendor. The admeaſurement of Caſſini ſets theſe bodies at an immenſe diſtance; this obſervation would place them at a much larger. It was but equitable to ſtate the two opinions, and, where ſo great authorities as that of Caſſini on one part, and that of Halley on the other, are oppoſed, it may be well to adviſe repeated experiments and obſervations farther to determine which is right. In the mean time it may not be amiſs to add, that, not only one ſtar, but two have been found to emerge in this inſtantaneous manner from behind the moon, as is the caſe in an obſervation made on thoſe two ſtars, which make what appears to the naked eye to be only one, and is called γ in Bayer's catalogue of the ſtars in Virgo. This pair of ſtars (for ſo they are found to be by a teleſcope of moderate power) have been ſeen to immerge and emerge again from the moon's diſk, and, although they be abſolutely two, and ſo apparently ſuch, that there is a ſpace between them, they have been ſeen to emerge together in their full brightneſs and luſtre, not firſt diminiſhed as if but ſeen in part. When things of the moſt nice kind come before the examination, we are not to ſubſcribe to the opinion of any aſtronomer, nor are we to give up the credit, if we were enclined to pay him from any obſervation of another that makes againſt it. We are to conſider the appearances, and the reaſons that favour both, and we are to compare obſervations of either of theſe, or of any others of good credit that are of a parallel kind, although made with a different intent; and, when we have thus compared, to call in our own obſervations upon all, diveſting ourſelves of prejudice, for it is the enemy to all truth.

Stars Fixed, *their Magnitudes.* The fixed ſtars are ſo numerous, that, in order to ſpeak of them with any degree of preciſion, all the poſſible methods were to be attempted of diſtinguiſhing them one from another. After they were arranged in little or larger cluſters into the figures of conſtellations, they were diſtinguiſhed as making parts of theſe, according to their apparent magnitude; we ſay apparent, for nothing is to be gathered as to their real proportional magnitude between one another from their appearances, under different ſizes, to our eyes. We know that objects appear ſmaller in proportion to their diſtance, ſo that thoſe, which appear largeſt of all to us, may be the ſmalleſt, only nearer to us than the reſt; and thoſe, which are ſcarce viſible to the naked eye, largeſt, only moſt remote. Nor is this all, we account them all to be ſuns, but they may be ſuns of different degrees of brightneſs; although globes of liquid fire, ſome may have more, and ſome fewer ſpots,

ſuch

such as we see in the sun, and we know, that, in proportion to the quantity of those spots, they will appear larger or smaller. We see, among the satellites of Jupiter and Saturn, that the satellite shall appear, at some times, larger, and, at others, smaller than those about it. This is not owing to any other cause than that the whole satellite, being spotted like that of our moon, only in some parts more, and in others less, it appears larger when a clearer part of its surface is turned toward us, and smaller when a more spotted part. Thus, if two of the fixed stars be supposed at the same exact distance from us, and exactly also of the same bigness, only one having many, and the other but a few of those spots which we see in the sun; it is certain, that which had but few would appear much larger than that which had many.

We see, therefore, that we cannot at all judge of the real comparative magnitude of the fixed stars from that which appears to us; however, as what does appear at one time also appears at others, and they keep the same proportion in the sizes they assume with respect to our eyes situated on the earth, it will, in point of use, answer the same purpose to fix their apparent magnitude as if it were; their real astronomers have, with this view, divided the fixed stars into six classes, under the name of those of the first, second, third, and fourth magnitude, and so on; those of the first being the largest, the others diminishing proportionably.

Although this division be, in some degree, proper, and, in many respects, very useful, we are not to suppose that it is precise or regular; it is no more than a gross assortment, for there are not, perhaps, any two of the whole heaven of stars that are exactly of the same size; and, among those of any one class, according to this received distinction, there are several that are larger and smaller than one another, and even many, that are called of one magnitude by some writers, are esteemed of another by others. The stars of the sixth magnitude are those which can but just be distinguished by the naked eye. We know that there are vast multitudes below these in point of apparent magnitude, which only telescopes discover to us, and even these so different among themselves, that several orders might be distinguished among them. But these are not taken into the account of the six classes, distinguished under the characterised degrees of magnitude.

The stars in the whole heavens, visible to the naked eye, are much fewer than any one would imagine, who viewed them only in the gross. We are induced, by their confused order, and by their twinkling, to suppose them much more numerous than they are; in the midst of the clearest and darkest night we see, in the northern hemisphere, or, in that part of the heavens which is exposed every way to our sight, only one thousand at the most, and of these only a very small number are of the larger kinds. These are visible to all people; but, with regard to the smallest, there are many of them that can be seen only by such as have peculiarly good eyes. The Seven Stars, as they are generally called, have been set down at six only by the far greater number of those who have written of them, and, to the generality of mankind, they appear no more, but here and there a man counts seven. The truth is, that, beside the several telescopic stars among them, there is a seventh very small, and only to be distinguished by an accurate sight. From the accounts of these stars, at different times, it has been supposed, that the seventh was a star that appeared at some times, and disappeared at others; but the truth is no more than this, that it is visible

to ſome eyes, and not to others, although a thouſand ſtars therefore may be ſeen by ſome people in a clear night, others will ſee only ſeven or eight hundred, and of theſe there are but three of the firſt magnitude.

The whole number of the fixed ſtars, viſible to the naked eye, counting at its moderate power, is but about one thouſand and ſeven hundred, taking in the whole extent of the heavens, and of theſe there are only ſeventeen of the firſt magnitude, there are but ſixty-three of the ſecond, of the third there are no more than one hundred and ninety-ſix, of the fourth there are four hundred and fifteen, of the fifth magnitude three hundred and forty-eight, and the reſt are of the ſixth.

STELLA HERCULIS, *the Star of Hercules.* A name we find, in ſome of the old writers, for the planet Mars. The Greeks were ambitious, that aſtronomy ſhould be ſuppoſed to have had its origin among them, and therefore they adapted part of their fables to the origin, as they called it, of the conſtellations, and of the ſeveral planets. They ſay, this ſtar was formed of their Hercules when he had ſuffered his untimely death; they tell us, that Jupiter took him up into the heavens, and there gave him an eternal being in the form of this ſtar, which takes, as they tell the ſtory, its ruddy, or fiery caſt, from the circumſtance of his death by fire.

STELLA NEMESIOS. A name given by ſome, who are fond of uncommon terms, to the planet Saturn; it is a ſtrict tranſlation of the Greek Nemeſios After, the ſtar of Nemeſis; and from this early appropriation to the goddeſs of revenge, the planet has been made the foreboder of ill luck by all the aſtrologers, and they have called it the ſtar of revenge, and ſtar of enmity, and the Latin writers, Infortuna Major.

STELLA SOLIS, *the Star of the Sun.* An old name given to the planet Saturn, the moſt remote of all in our ſyſtem. To underſtand why it was called by that ſingular name, we muſt examine into the Grecian fables in the hiſtory of the heavens.

The Greeks, a vain and ambitious nation, received the rudiments of aſtronomy from the Egyptians, they improved it to ſuch a degree, that what they had obtained was little to what they added; they found they ſhould have the honour of teaching the ſcience to the reſt of the world, and they burned to be underſtood as the abſolute inventors of it. It was eaſy for them to conceive, that in order to trace aſtronomy to its true origin, men would enquire into the meaning of thoſe emblems they had uſed in it, we do ſo at this time, and we find, by ſuch enquiry, that the Egyptians themſelves, who taught this ſcience, had it from elſewhere. Aquarius, the ſign betokening the rainy ſeaſon, though taught by the Egyptians to the Greek, yet could not have been found in Egypt, becauſe there is no rain there; and the harveſt ſign of Virgo, with her ear of corn, being an autumnal part of the zodiac, could not be deviſed in Egypt when the harveſt is in April.

The Greeks, who underſtand the true meaning of the figures in the conſtellations, did not diſcover this foreign origin of the ſigns, even with reſpect to the Egyptians, but determined that they would not be eſteemed by others foreign, even to them, they engrafted ſome part of their hiſtory, or fable, to every one of the conſtellations, and upon all the planets. The Swan was that in whoſe ſhape their Jupiter debauched Leda; the Eagle, or Vulture, for they called it either, was that which preyed upon Prometheus's liver, and ſo of the reſt. Thus alſo they accounted for the origin of the planet Jupiter, which they

they called Phaethon; they tell us he was a mortal of that name, of a very beautiful person, whom Jupiter, judging too good for earth, took up into the skies.

Thus also Saturn came by his place, they say, in heaven, and thus he certainly came by his name of Stella Solis. They tell us, that this planet owes its origin to the destruction of Phaeton, the offspring of the sun. The youth obtained permission to guide the chariot of his father for one day, and tumbled out of heaven. Jupiter struck him dead with thunder, and he fell, they tell us, into the Eridanus; but his father Phœbus took him out, and raised him into the heavens, making of him that bright star which he placed at the greatest distance of all others, from that fatal mansion the sun, in whose cause he had obtained his destruction.

Stella Terrestris. A name given by some to the bright star, called, more usually, Canopus, in the stern of the ship Argo; it is called by this name, because those who lived in Greece, whence it had its origin, always saw the star near the horizon, and this only in the most favourable part of the country; for the greater part of the constellation Argo was quite unknown to many of them, and must have been found in Egypt. Plutarch, indeed, tells us, expresly, that it was, and that it was formed in commemoration of Osiris's ship.

STEPHEN, *or* St. Stephen. There is not a saint in the whole rubric whom Schiller has not, by this science, as he pursues it, raised up into heaven. St. Peter takes the place of Osiris, and St. Andrew of the Bull in the zodiac. The Cepheus, of the antient sphere, makes the St. Stephen of the new enthusiasts; but they are not perfectly agreed about this; for Hartsdorf, who always goes back to the Old Testament, calls this figure Solomon. *See* Cepheus.

STILBON. A name by which some of the early astronomical writers have called the planet Mercury, the word signifies radiant, or bright; and the light of this planet, when it is not at a sufficient distance from the sun, to be seen advantageously, is vivid enough to have deserved it.

STORK. An Arabian constellation; it stands in the place of the Ophiucus of the Greeks; they were not permitted, by their religion, to draw human figures, so were forced to this alteration.

SUCULÆ. A name by which many of the Latins have called the five stars in the face of Taurus, which the Greeks called Hyades; these were very early distinguished by their Greek name, and originally so; for the Egyptians, from whom the Greeks borrowed the knowledge of this science, had not distinguished them by any particular term. The distinction was very early, for Hesiod mentions them under the name of Hyades; and we have no author extant, the sacred writings excepted, that is older than Hesiod, in whom the constellations, or indeed any of them, are named. The Pleiades, Hyades, and Arcturus, were evidently of Greek origin; but Sirius and Orion, which he also mentions, were of foreign origin. The Suculæ, or Hyades, were supposed a rainy constellation.

SULAPHAT. A name by which some, who are fond of uncommon words, have called a bright star in the constellation Lyra, called Lucida Lyræ. Sulaphat is one of the Arabic

Arabic names of that conſtellations, and alſo of that ſtar; we find it in Ulugh Beigh's tables of the conſtellations.

SUMBELA. A name by which ſome have called the conſtellation Virgo; it is properly the Arabic name of the bright ſtar in the ear of corn, which is in the hand of the conſtellation, and which is uſually called Spica Virginis, but it is ſometimes uſed for the whole.

SUMEZ. A name by which ſome, who are fond of unuſual words, have called the planet Mercury; it is a Phœnician name of the planet, and it expreſſes, in that language, an attendant. Mercury is called by many different names, the proper ſignification of which is attendant, and they have probably been given to it as neareſt to, or moſt cloſely attendant on, the ſun. We find the word Semo uſed as a name of this planet alſo by ſome of the Latin writers, and there is an obvious explication of it, as loweſt; they called the loweſt of their deities, Dii Semones; yet poſſibly the true origin of the word may have been from the Phœnician, Sumez, ſoftened in the pronouncing into Semo.

SUMMER TROPIC. A term by which ſome writers expreſs the tropic of Cancer. The one name is given to it from the ſeaſon of the year at which the ſun arrives at it; the other from the conſtellation through which it paſſes, that is the Crab. This tropic is the fartheſt northern parallel which the ſun deſcribes; or, in other words, it is that circle which the ſun deſcribes by his diurnal motion which is moſt diſtant from the equator to the north, as that which is moſt diſtant to the ſouth is called, from the ſeaſon of the year in which the ſun deſcribes it, the winter tropic, or, from the ſign of the zodiac through which it paſſes, the tropic of Capricorn; theſe circles have the name of tropics in the Greek, becauſe they are the parts of the heaven from whence the ſun begins to return to the equator, having made his fartheſt declination one and the other way from them, when he has arrived at that place in the heavens, through which a parallel being drawn, makes this extreme circle, or this tropic.

The ſun is in the equator only twice, that is two days in the year, theſe are the tenth or eleventh of March, and the eleventh or twelfth of September; on each of theſe days his diurnal revolution is performed in the celeſtial equator, but only on thoſe days. To come to the ſummer tropic, of which we are to ſpeak here, when the tenth or eleventh day of March, on which the ſun's place is in the equator is over, he is ſeen the next day in a new place, a little way north of the equator, and his diurnal motion, for that day, is in a parallel which paſſes through the point of that place, that is, it is performed in a parallel a little north of the equator. On the next day the ſun's place is a little more north of the equator, and conſequently his diurnal motion is alſo in a parallel a little more north of the equator, and ſo on; theſe daily changes of place are but very ſmall; but as it is certain, that the ſun is ſeen every day in a different part of the heavens, it is equally certain, that its diurnal motion is every day in a different parallel, though theſe removes are ſingly, but ſmall; yet, in the whole, they amount to ſomething that is not ſo. This declination of the ſun, nor this continued every day for three months, or till the eleventh of June, in all this time the advance to the north has been very conſiderable; the eleventh day of June is the laſt of its continuing this declination,

declination, consequently it is the day on which the sun is seen most north of the equator, and on which his annual motion is in a parallel, the most remote that it can be from the equator. As the sun never remains in any place during his annual revolution, being come to this most remote part of the heavens that he ever occupies north, he begins to return back toward the equator; it is for this reason, that the circle which he describes in this his greatest declination north, is called the tropic, or the circle of return; and from the time of his making his diurnal motion in this most remote parallel, which has the name of the tropic of Cancer, because it passes through that sign, he every day is seen in a place nearer to the equator, and his diurnal revolution describes a parallel nearer to the equator for three months more, or until the twelfth day of Steptember, at which time, having come back to the equator again, his diurnal revolution is performed again for one day in the equator, and from thence never resting any where, it begins to change its place south, and to make its way toward the tropic of Capricorn, which is called the winter tropic, and from which it in three months more, that is between the eleventh of December, on which day it reaches that tropic, and the tenth of March, again recovers its place in the equator, and begins to decline north again.

When we speak of the sun's motion in all this, it is only to conform to appearances, and common speech; it is the earth's motion that does all; but the appearances to us, who live on the earth, are the same.

SUN. The sun is the first and greatest object of astronomical knowledge, and is enough to stamp a value on the science to which the study of it belongs. There have not been wanting, in the less improved times, those who have erred extremely about the nature, situation, and the motions of this luminary, but its vast importance to the inhabitants of this earth is a thing to which all eyes must be open. We see it the sacrum of light and heat, we see it the parent of the seasons, day and night, summer and winter, are formed entirely by it, and all the vegetable creation are the offspring of his beams, even our own lives are not to be supported but by its influence, and, where it has least power, we find that life hardly deserve the name of a blessing. It is in the heart of a man to value what he possesses, but, to any who have seen a happier climate, the frozen regions seem to make life a punishment.

The earliest astronomers, Philolaus and his predecessors, declared, the motion of the sun round about the earth to be only apparent. They saw the importance and superiority of such a globe over ours, and could not suppose it formed only to give us light, and that they imagined its influence extended throughout much larger bounds, and they placed it in the centre of the universe, and supposed it fixed without any motion.

Appearances weighed more than judgment in the succeeding times. Ptolemy, long since, and, of a much later time, Tycho Brahe, have made the sun revolve round the earth. This, though it correspond with common appearances, is absurd and idle. It were as wise for a man, who is carried along the river in a boat, to suppose the houses and churches on the shore ran by him, because he did not perceive his own motion; as to imagine so immense a body as the sun rolled round about such a spot in the universe as this earth, because the eye, not perceiving the motion of the earth, is led to see it so. Ptolemy was very faulty in taking up a vulgar opinion in the

place

place of that of his wiſe predeceſſors; but what ſhall be ſaid of Tycho Brahe, ſo great a man, who yet eſtabliſhed ſuch a ſyſtem after the time of Copernicus. The diſtance, at which that writer, and at which the Author of nature has placed the fixed ſtars from us, was too great for the imagination of Tycho. It was neceſſary they muſt be at that diſtance, or elſe that the earth muſt not move, for they have no ſenſible parallel; incapable to believe the former, he determined for the latter, and, while he ſtruggled againſt a wonder, ſwallowed an abſurdity. In conſequence of his diſagreement from Copernicus in this article, he fixed the earth in the centre of the univerſe, and ſuppoſed the ſun to roll round about it. This ſyſtem makes the ſun a planet, but this is ſufficiently overthrown by numberleſs obſervations. At preſent, all men agree with Copernicus, that the ſun is fixed in the centre of the univerſe; and that all the planets, of which this earth, which we inhabit, is one, roll round its body. This is taking ſomething from the importance of our world, but we ſhould not glory at the expence of truth. It is certain, that the earth is not the great point in the ſyſtem, but is one of the ſeveral orbs that roll round about the ſun.

The ſun is a ſpherical luminous body. The moon and the planets give light to us, but that is not inherent in them, they are in themſelves opake, and what light we have from them, they firſt receive from the rays of the ſun, and then reflect to us. A looking-glaſs has no light in itſelf, but it may be ſo placed as to receive the rays of a candle, which we do not ſee, and throw them back to us. But the ſun is, in itſelf, poſſeſſed of light; it does not borrow this from any other, but, being a body of fire, it ſhines as ſuch; it expands all about it to a great diſtance, ſo as to enlighten, as already obſerved, not only our earth, but all the planets, of which ſome are immenſely more remote. The fixed ſtars, on the contrary, have, like the ſun, their light in themſelves, and are otherwiſe at too great a diſtance to reflect to us.

That the ſun is a body of fire, appears to the ſenſes; but we have had a ſet of philoſophers of late, who, right or wrong, would never have us believe their teſtimony: becauſe they miſlead us in ſome things, they think they muſt do ſo in all; and becauſe we have been taught to depart from their teſtimony when reaſon points out otherwiſe, they would have us diſpute, or contradict them, when there is no reaſon to doubt their being right. The old philoſophers all declared it a body of abſolute fire. So Plato, Zeno, and Pythagoras, expreſs themſelves; and ſo, among the moderns, Kepler, Kircher, and the greateſt who have followed them; but Deſcartes and his followers ſay otherwiſe; they would have us believe that there is no abſolute fire in the ſun, but that it is a vaſt globe, compoſed of a ſubtile matter, capable of exciting the ſenſations of light and heat. This is ſubtile talking, but the beſt way to examine its validity, will be to examine the ſun itſelf. This we may do by teleſcopes properly prepared, and by receiving the image of the luminary into a darkened room.

The ſun is too bright for the view of the naked eye, his luſtre dazzles, and takes away the power of ſeeing, if we attempt to look directly at him; but ſometimes there are rays that render the atmoſphere about us a medium through which we may ſee him without pain, but then not diſtinctly. A thin cloud anſwers the ſame purpoſe; and we may alſo view him near the horizon, but we can diſtinguiſh from ſuch obſervations; all that we ſee, is, that the figure of the ſun is round. A piece of glaſs, blacked with ſmoak, will, at any time, do the

the office of a cloud, or of a fog, and we may thus see his figure and out-line, but that is all. We see the disk throughout of one uniform colour, which varies according to the degree of blackness there is upon the glass. When we view the sun through telescopes, we perceive the same round figure; but we see on its disk certain spots, less brighter than the rest, which we did not distinguish by the simple view; these spots are usually black, and they have round them an edge of brown. This is a little clearer in the inner part, where it adheres to the black; on the exterior, the figure of these spots in the sun's face is irregular, and they are not fixed and certain in their form or situation, but liable to many changes. It is a common thing, on repeating the observation, to see a number of these spots together at no great distance from one another, and to find that they daily change place with regard to one another, and even change in number.

The spots are yet subject to greater variation, for they are not permanent, but will disappear at times; and, if they appear again, it will be in a different form, so that it is hard to say, whether what is seen is the old spot, or is another in the same place. The time of the duration of these spots is as uncertain as their figure, but they have seldom a very long duration. The observation of those, which have continued the longest, has not given them more than eight or nine weeks duration; many of them appear, and are lost again, in as many days, or in yet less time. How this is to be reconciled to Descartes's subtile matter, is not easy to say; but, supposing the sun a body of absolute fire, it is very natural to imagine that such changes will happen.

The dispute, as to the discovery of these spots in the sun's disk, lies between Scheiner and Galileo; it was made about an hundred and forty-two years ago. However that be, it was almost a necessary consequence of seeing the sun through a telescope, for it is very rare that the disk is wholly clear of them; Schiner says, he has counted fifty of them on it at the same time, at present twenty or thirty is sometimes a common number. In this, however, there is a great deal of variety, and it is singular enough to observe it. There are some years in which it is rare to see more than one or two at a time. We have accounts of years, in which there have been none discovered; in others we see the number, and the extent of them, both very great. It is evident, therefore, that there is no sort of regularity either in the number or figure of these appearances; but notwithstanding that neither of these has any regularity; there is, in a more important point, a constant and invariable order, this is in their motion. They do not appear fixed always in the same places, but regularly move from east to west as seen from the earth; but, to speak of their real motion, we must suppose the point of view to be in the centre of the sun, and their motion would then be from west to east, which is the true course of it, and is the same with all the other motions of the heavenly bodies.

When the spots of the sun were first observed, there was no doubt whether they did immediately touch and adhere to the body of the sun, or whether they were at some small distance from it, and were a kind of planets forming a quick revolution round it, like those of the earth and the other planets, only this is slower in proportion to their distance, but it was soon determined that they are really adherent to the surface of the sun, although elevated above the general plane, and are parts of its body, and not distinct bodies moving round it.

In the obſervations made on the ſpots, it is the general rule, that thoſe which are neareſt to the centre of the diſk appear largeſt, and thoſe neareſt to the edge ſmalleſt. This appears not only in our own obſervations, but in all the figures of the ſun's face, which have been drawn from thoſe of others. It appears alſo, that the ſpots about the centre are of a kind of roundiſh figure, and that they loſe this as they depart from it, becoming elliptic at firſt, and, at the laſt, when near the edge, ſo narrow, that they appear almoſt as ſtrait lines. We learn two things from this appearance. Firſt, that the body of the ſun is abſolutely globular or ſpherical; and the other, that theſe ſpots are flat, or not very much elevated, but are cloſe to its ſurface. The face, or diſk of the ſun, appears not hemiſpherical, but flat, as we view it, whatſoever way; but this is a deceit in viſion, a common bullet, heated red hot, appears alſo, when viewed from a little diſtance, not ſpherical, but flat. For the other obſervation, we know, by the laws of optics, that a portion of the ſurface of a globe, ſeen near its centre, muſt appear a great deal larger than when it is ſeen near its circumference; when, on the other hand, a body, detached from the ſurface of a globe, if of a proper thickneſs, would appear to occupy the ſame ſpace upon it, whether viewed when near the centre, or near the circumference. If we ſuppoſe a round and flattiſh ſpot, on the ſurface of the ſun, changing its place, we ſhall ſee it, when near the centre, in its full ſize, becauſe we there ſee its horizontal diameter, but, when it has got near the circumference, we ſhall ſee only its vertical diameter, and it will appear, inſtead of a large round plane, only a fine and ſmall ſtrait line. We ſhould, indeed, ſee the very ſame appearance if this were detached from the ſurface of the ſun, but at only a very ſmall diſtance from it, and more flat in ſhape, and conformed itſelf to the body of the ſun; it would then be in the condition of a cloud placed in an atmoſphere. This would not at all be the caſe with a globular body that ſhould, at ſome greater diſtance, perform its revolution round the ſun. We ſhould ſee this, in all parts of its courſe in which it was viſible to us, occupying the ſame ſpace upon the ſurface of the ſun, whether we ſaw it over the centre, or near the circumference.

But this is not all that we have to prove the ſpots of the ſun to be adherent to his ſurface, or, if it be otherwiſe, very near to his body. By this we may alſo know, that they are about as long a time upon his ſurface as they are loſt behind it, which could not be the caſe if they made a revolution round his body at any conſiderable diſtance. For inſtance, if we ſuppoſe a ſpot to be a ſolid body, placed at the diſtance of one ſemidiameter from the ſun, and revolving round that body, the time in which it would appear as a ſpot upon the ſurface of the ſun, would be only while it was running through a certain part of its orbit, which the diſk of the ſun takes up with regard to us. This being but about one fifth or ſixth part of the whole orbit of ſuch a revolving body, we muſt neceſſarily ſee the ſpot upon the ſurface of the ſun only during the time of one fifth or ſixth part of its whole revolution; that is, it would be unſeen five or ſix times as long as it would be ſeen. On the contrary, if we ſuppoſe the ſpot to adhere to the ſun's ſurface, we muſt ſee it during its performing half its revolution, and loſe it juſt the other half.

Farther, theſe ſpots are proved to be upon the immediate ſurface of the ſun, or elſe at a very little diſtance from it, for the appearances will be the ſame in both theſe caſes, by meaſuring their courſe over its apparent diſk; for, if we meaſure the ſpace which they run over

in

in four and twenty hours, or that time when they are about the middle of its disk, we shall find that they return to the same place, after having finished their whole revolution round its surface in a space of time proportioned to the space they had run over in the first four and twenty hours. This must happen if the spots are either immediately upon the surface of the sun, or at a very little distance from it, but it could not, were the bodies, that revolved round it, at any considerable distance. To all this it may be added, that the number of variations which we see in these spots, their augmentation and diminution, and the great irregularity of their figures, as also that kind of cloudy border that surrounds them, could not be seen in bodies that were at any great distance from the sun. It is evident, therefore, upon the whole, that these spots are either very near to the surface of the sun, or immediately fixed upon it, and the latter is by much the most probable. Thus much we may collect of certainty from our own observations, and those of others. It remains to enquire what these spots really are.

It has been supposed by many, that the sun is naturally a solid, opake, and irregular body, having, like this earth, hollows, plains, and mountains, and that its whole surface, with all these irregularities upon it, is covered to a certain depth with a fluid of matter, which is luminous; and they suppose that this fluid, being liable to motions, sometimes is collected into a quantity, in some particular hollow, and consequently leaves the tops of these rocks or mountains bare, and that these, appearing above the surface of the fluid, covering, and not having its luminous quality, form the opake spots which we see; and they suppose a sort of froth or foam, made by the motion of the fluid round about these rocks, which makes that nebulosity, or brownness, seen all round their circumference. These prominences, they say, are covered when the fluid runs back again into its old place, and then some others, in other parts, are exposed by the same fluid's deserting them as it did the first. If, at any time, these spots appear again, it is not, on this principle, a wonder that they are not exactly the same in form or dimensions as at the first, for that more or less of the eminence may be thus left uncovered; but this they alledge, as a very probable occasion of the same spots appearing at different times.

The supposition of the sun being an opake body covered by a luminous fluid, has not been limited to these. There have been others, who, supposing the structure the same, have found another way to account for the spots. They suppose, that, in this solid body of the sun, there are vulcano's, like our Ætna and Vesuvius, which throw forth, at times, great quantities of matter which thus deform the sun in spots, rising up above the fluid surface, like the famous island near Santerini, out of the sea at once. They suppose that this matter is, by degrees, consumed, and taken into the fluid mass upon the surface of which it at first floats, and that, as this is a work of time, the first appearance of the effect of the burning fluid is the making that brown circumference, or nebulosity, which we see about the edges, and that, after this, the spots, by degrees, change figure, as they are more and more consumed, till they are wholly swallowed up and disappear. This system also accounts for their often re-appearing in the same places, and in different forms; because the volcano's may continue where they were, and, from time to time, throw up quantities of new matter, though sometimes more than at others.

Others have ſuppoſed the ſun a much more ſurious and turbulent quantity of matter; they imagine it to be compoſed throughout of a boiling fluid, but that there are, among this, certain maſſes of ſolid matter, immenſely great, but of irregular figures; they ſuppoſe the vaſt maſs of fluid to be in continual motion, and to be at times plunging theſe ſolid maſſes down, and, at times, throwing them up to the ſurface, and ſhewing more or leſs of their bulk. This will better account for all their irregularities, than for their re-appearing in the ſame places; but as this does evidently happen often, there ought to be ſome account of it in any ſyſtem that pretends to explain their appearance.

Finally, others have determined, that the body of the ſun being compoſed of a ſubtile and fluid matter in continual agitation, the fouler or thicker parts, of whatſoever kind, are, by that motion, ſeparated, time after time, from the reſt, and that, being thrown up to the ſurface, they float upon it like the foulneſs of metals when melted, and, by degrees, getting together in cluſters, in form of ſcum, conſtitute thoſe ſpots which we ſee on the ſurface; theſe parcels of ſcum being agitated by the boiling matter underneath, muſt be frequently altering their ſhape, as we ſee thoſe ſpots do, and move farther from, or approach nearer to one another; and that, in fine, the ſame agitation which threw them, may, by degrees, diſſipate them, till they are no more ſeen.

The continued obſervation of the ſpots of the ſun has ſhewn, that they perform their revolution round its body in about twenty-ſeven days; we ſee them move from eaſt to weſt in a regular manner, and after they have thus travelled over one of the hemiſpheres in thirteen days and an half, they are loſt to us; they continue unſeen a time, equal to that which they took in runing over the hemiſphere, on which we obſerved them, and, at the end of that time, they appear again on the oppoſite verge to that where they were laſt ſeen; this makes it plain, that they have been making a revolution in the time they have been hidden from us, over that hemiſphere, which is alſo hidden from us, and their return to the point whence they ſet out in about twenty-ſeven days, fixes that for the period of the revolution; it is a few hours more, but this is trivial.

It is evident from this appearance, either that theſe ſpots have all of them a regular and periodical revolution round about the body of the ſun; or elſe, which is much more probable, and will occaſion the ſame appearances, that the body of the ſun itſelf does turn round on its own axis, and carry with it, in that motion, theſe ſpots which are fixed to, and a part of its ſurface. Reaſon, and the general courſe of nature, declare for this latter being the caſe, and conſequently we have diſcovered, by the obſervation of theſe ſpots, that the ſun does turn round its own axis, and that the revolution is performed in twenty-ſeven days, and ſome hours; that this is the caſe, is, indeed, evident from the conſideration, that theſe ſpots are really, for ſo they truly are, adherent to the ſurface of the ſun, and therefore incapable of any change of place, otherwiſe than with the whole body of the ſun; truths, in this manner, eſtabliſh one another. It is evident, that the ſun does revolve round its own axis, and it is evident, theſe ſpots are, with the reſt of the ſurface, carried round by this motion, and that they therefore are not ſolid bodies performing a revolution of their own round about the ſun at a diſtance, nor ſubſtances, like clouds, hanging near it, but that they are truly parts of its ſurface. In order to aſcertain the time

which

which the ſun takes in this revolution on its own axis, and the direction of that axis, with reſpect to ſome fixed point in the heavens, it is neceſſary to determine abſolutely the places of certain of theſe ſpots with reſpect to the great circles of the ſphere, during their whole apparent motion over the ſun's diſk; in the ſame manner, as in the heavens, we aſcertain the places of the ſtars, with regard to the ecliptic and equator, and on the earth, the ſeveral regions, and tracts of land, with reſpect to the different circles of the ſphere. We are to conſider, to this purpoſe, that the centre of the ſun, and that of the earth, being placed on the plane of the ecliptic, the ſection of that plane in the diſk of the ſun, ſeen from the earth, ought, according to the laws of optics, to appear in form of a ſtrait line, or a diameter paſſing through the centre of the ſun; it is with reſpect to this line, which is invariable throughout the courſe of the year, that we are to determine the place of the ſeveral ſpots which are the ſubject of our obſervations.

With regard to the parallel which the ſun appears to deſcribe in his daily revolution, we know, that it is found differently inclined to the plane of the ecliptic on different days of the year; and as it is with reſpect to this parallel, and the circle of declination which is perpendicular to it, ſo we determine immediately, upon the ſun's diſk, the ſituation of the ſpots; this is the principle, and upon this all the reſt is eaſy.

Thoſe who are not accuſtomed to aſtronomical calculations, will be ſurpriſed at the real magnitude of that luminary, which, from its vaſtly greater diſtance, appears to us no larger than the moon, which not only appears to be, but is, a ſmall and ſecond planet, a ſatellite, or attendant on this earth. What will be their aſtoniſhment to hear that, when looking at the ſun, they are viewing a globe of ſolid and of liquid fire, for that is probably its ſtructure, the diameter of which is equal to an hundred diameters of the earth, whoſe thickneſs, in more plain terms, is ſeven hundred and ninety three thouſand miles; that its ſurface is equal to ten thouſand times the ſurface of the earth, and whoſe ſolidity is a million times as great; this is the true ſtate; according to the beſt calculations the ſun, ſmall as it appears, being a thouſand, thouſand times, as big as the earth.

If we could ſuppoſe an obſerver of the heavens to be placed in the ſun, his eye from the centre of that luminary would ſee the fixed ſtars, and the planets, in a ſphere, juſt as they appear to the eye that views them from the earth. The Milky Way would appear in the ſame form, and the fixed ſtars diſpoſed into the ſame conſtellations. This earth is carried in a great orbit about the ſun, and the ſtars appearing from their vaſt diſtance, in the ſame ſituation, from whatever part of that orbit we view them, it is plain they would alſo appear in the ſame manner from the ſun; it is plain, from the ſame conſideration, that the fixed ſtars will alſo remain in the ſame order with reſpect to the eye, if ſeen from the moon, or from the planets Mercury and Venus, their orbits being leſs diſtant from the ſun than that of the earth, and the moon going always with the earth; nay, in the remoteſt planet Saturn, the change, in this reſpect, could be very little and inſenſible; for although the diſtance of Saturn from the ſun be ten times as great as that of the earth, and this to us appears a great deal, yet with reſpect to the diſtance of the fixed ſtars it is, as it were, nothing.

The planets would be ſoon diſtinguiſhed from the fixed ſtars in ſuch a ſituation, becauſe thoſe ſtars always remaining in their places,

places, the planets would be seen passing by them; this motion would be found quicker in Mercury than in Venus, and slower in Saturn than in any of them; and one of the first conclusions would be, that of Saturn was therefore the most remote, and Mercury the most near, and the places of the other planets, and of the earth among them, would be determined from the same principle. The old astronomers used a method like this, to determine the distances of the planet from the sun; and they did it rightly as to the upper, or superior planets; but the mean motion of the others appearing equal, it was not so easy to determine. Indeed they were at a loss to know the complete revolution, because the planet after it had performed one, did not return to the same fixed stars as viewed from the earth; the reason of this was, that the earth itself had changed place, and was got into another part of her orbit, to determine justly, it was necessary to know, first, that the earth, and this motion round the sun, and in what period it was performed.

The eye placed on the surface of the sun will not at any time see the shadow of any thing, nor any eclipse; for a very plain reason, namely, that shadows are always turned from the sun; but when one of the planets have satellites to accompany them, when the planet is in the horizon, the satellite would appear in the penumbra of it, or the penumbra of the satellite, may, in this case, appear cast upon the disk of the planet to which it belongs.

As to the comets, when they are seen from the sun, they would always be of what are called the hairy kind, they could never have tails. We know, that this appearance in a comet, seen from the earth, is only owing to its situation; for if the comet be in opposition to the sun, with the earth between them, the tail can be no otherwise seen than in form of a rim of hair, it being cast directly behind the comet, and only shewing itself, because of its larger diameter, which the body of the comet is not big enough to hide. If this be the case with all comets, when seen by the earth in a line with them, or nearly in a line with them from the sun, it must also be the case when they are seen from the sun, and consequently all comets, and at all times seen from the sun, will appear hairy.

But nothing would afford a greater variety, of appearnce than this earth; it would appear as one of the planets, and no more, but its surface would have, at various times, a very different appearance; sometimes it would be covered with dark dense spots, and these as observed in their motion round its surface, would change their figure, and, by degrees, vanish, such as were broad when seen near the centre, would become narrower, as viewed moving toward the edges, and all would happen, that we, at this time, see with respect to the planet Jupiter. Sometimes the whole surface would appear plain, and free from them, and, by degrees, larger or smaller, and more or less would appear again; this would all happen from the earth's revolution round its own axis, in which she would at sometimes turn a face almost all sea, and at others nearly all land to the eye so placed; this may account for the changes of the face of Jupiter, and the other planets, for they are all caused by their revolutions round their axis.

It is not much to the credit of Thales, or, at least, it appears, upon the face of the account, not much to his credit to have calculated the sun's bigness. Laertius tells us, that one of his principles was, that the sun was but of a seven hundred and twentieth part of the bigness of the moon. This, which con-

tradicts

tradicts all our ſenſes, as well as our reaſon, could never be the determination of that Thales, famous throughout the learned world, for having brought from Eygpt, the country where all that was known of aſtronomy was then centred, the ſcience into Greece; but perhaps from ſo palpable an abſurdity, it may be, without much violence, conſtrued into the greateſt of all the compliments that have been paid him, that even Laertius could have ſaid, what ſtands in his work muſt be impoſſible; it is an error of the tranſcribers, beyond all doubt, and the word moon, in the original, muſt have been truly and properly zodiac; this will ſet the credit of Thales upon a new footing of reſpect. He tells us, according to this interpretation, that the ſun's diameter is equal to a ſeven hundred and twentieth part of his annual orbit: if we examine this we ſhall find, that he made the ſun's apparent diameter thirty minutes in meaſure; and what do the preſent obſervations make it? thirty-one, or thirty-two, and ſome odd ſeconds. This is an approach to truth, greater than it was poſſible to conceive could be made in thoſe times.

Nothing could be ſo obvious as the ſun's change of place in the heavens, that is, his apparent change of place, with reſpect to this earth, to all who gave the beſt attention to obſervations of the heavens, and it muſt have been palpable to them, that to this change of place in the ſun was owing the different length of days, and almoſt all the variety of appearances in the years.

When we meet with ſome who, though writing in ſome degree upon the ſubject, yet appear to have been ignorant of this, we are to refer it to their wild and inconſiderate obſervation. If we ſhould ſet a ſtranger to the works of art before a clock, and aſk him whether the hour-hand moved after he had been but a few minutes looking upon it, he would aſſuredly anſwer it did not, but bring him to it after ſome hours, and being convinced by its apparent change of place that it had moved ſince the time of his laſt obſervation, he would confeſs it did move, and if he had any degree of curioſity, he would then ſit down before it, and enquire into the manner.

It is exactly thus with reſpect to the ſun. Nothing is more certain, than that this luminary appears in a different point of the heavens every day of the year, but his daily motion, or change of place, is like that of the hour-hand of a clock with reſpect to minutes; it is not ſeen, unleſs when the examination is made after ſome time. Thus, if the ſun be remarked for a few days together, it appears like the hand for a few minutes, to continue in the ſame place, at leaſt, as the one could only be ſeen by the moſt curious inſpection, ſo the other can only be found by the nice aſtronomical obſervations; and from this it is, that when talking of the viciſſitude of night and day, or the like temporary things, it is common, even with aſtronomers, to ſpeak of the ſun, as occuping the ſame place for the four and twenty hours, though, in ſtrict juſtice, this is no more true than that he had occupied the ſame place for any two minutes; but it muſt have been otherwiſe with reſpect to thoſe who even, in the rudeſt times, made any continued obſervations; from theſe they muſt ſee, that after any number of days his place was very different, and from this obſervation they were naturally led to examine his riſing and ſetting, at the times of the moſt eaſy and moſt certain obſervation as to this change of place, and from theſe they were led into the knowledge of the period, and diviſions of the year, and almoſt every other article of the civil aſtronomy.

They found that the ſun roſe every day in a different part of the horizon, and among different ſtars, although this was not ſo very palpable in the courſe of one day, it was very obvious after ſeveral, and, according to this obſervation, they found him, at the end of a certain time, returning to the ſame point again. This marked his whole revolution, and this was a year. The reſt of the diviſions then were eaſy.

It is from this continual change in the heavens that we owe the different length of days, and the different ſeaſons of the year; that we ſee the ſun, at ſome times, much higher in the heavens at noon, as is the caſe in ſummer, and much lower, as is the caſe in winter. It was in theſe terms of changing place that the antients ſpoke of the ſun's varied poſition in the heavens with reſpect to the earth, for, being ignorant of the true laws of the heavenly bodies, and of the real ſyſtem of the univerſe, they, for many ages, did really believe that the ſun moved, but we know that it is the earth that moves, that the ſun occupies the centre of the univerſe, and never changes place at all, and that all this apparent change of ſituation is occaſioned by the revolution of the earth, on which we dwell, about that luminary. This, however, produces exactly the ſame appearances as if it was the ſun that moved, and conſequently we ſpeak in the uſual terms, and talk of the ſun's motion, although that of the earth is what is always meant. The earth moving, we, who are upon the earth, change place, and conſequently, ſeeing the ſun from different ſtations at different times, he appears to us to have moved. The caſe is no other than with reſpect to the viewing a building, or any other fixed thing, as we are ſailing along in a veſſel. If we ſuppoſe a church, in the place of the ſun, and ſome hills and trees at a diſtance behind in that of the fixed ſtars, and ourſelves in the boat, the earth, we ſhall ſee the whole deluſion in the moſt plain terms. As we ſet out, we ſee the church oppoſite to ſome one tree, as we go on it becomes ſucceſſively oppoſite to others more and more remote, and if, after all, we come back to the place from whence we ſet out, the church will then be oppoſite again to the ſame tree at which we firſt ſaw it. By this we ſhall know that we are come to the ſame place again; and all this time the church will appear to have moved with reſpect to the diſtant trees and hills, juſt as the ſun, in the courſe of the year, appears to have moved with reſpect to the conſtellations, while all the time it is we in the boat who have moved on the one hand, and we on the earth who have moved on the other, the churches, and the trees, and the ſun, and the conſtellations, having kept very ſtill in their places.

What the equator is, has been already explained in its place; and from the knowledge of that, and the conſideration of this revolution, and continual change of place in the earth, and the conſequent apparent change of place in the ſun, it will be eaſily ſeen that this luminary will ſometimes appear in that equator, and, at other times, will be ſeen to the north, or to the ſouth of it. When the ſun is thus in the equator, his diurnal motion (to continue to uſe the ordinary terms) is in that equator; and, on the other hand, when the ſun is to the north, or to the ſouth of the equator, wherever his place for the time is, the diurnal motion, which he appears to make round the earth, is in a parallel drawn through that point. This is the general caſe, for it is only twice in the year that the ſun is abſolutely in the equator; at theſe two times, as already obſerved, its apparent motion is in the equator for the day, and, at all other times, he is either in a greater or leſſer north

or

or south declination; in the first case, his diurnal motion is in a northern parallel, and, in the other, the same motion is performed in a southern parallel.

If we examine the heavens, we shall find, for instance, that, about the tenth day of March, the sun's place is in the equator, and consequently his diurnal motion is then in the equator: but, if we continue to observe, we shall find, that, from that day, his place is more and more north of the equator, and consequently that his diurnal motion is in a parallel north of the equator, and that this parallel becomes more and more north of the equator for about three months. At the end of this time, that is, about the tenth or eleventh of June, the sun has gone as far north of the equator as he ever goes. This, in the astronomical term, is, the sun is in his greatest northern declination; and his diurnal motion is, at this time, made in the parallel, the most remote from the equator, to the north, of any that he ever describes by that motion.

From this day, on which the sun has made his greatest progress north, he begins to return again, and his place is, every day, something nearer to the equator than it was the day before. It has been already observed, that, wherever the sun's place is, his parallel, for that day, is drawn through that point, so that we see the sun is, from this eleventh of June, performing his diurnal revolution in a parallel, that is, every day more and more near to the equator. This happens continually for about three months more, at the end of which time, as the motion of declination and return has been about equal, he is found in the equator again. Thus, about the twelfth day of September is the day on which the sun is, for the second time in the same year, in the equator, and his place being in that circle, his diurnal motion is, for that day, as it was on the other day in March, performed in that circle. Thus has the sun gone through the summer months.

The twelfth of September is the day on which he begins his winter journey. From this day he is seen every day in a new place, which is more and more south of the equator, and consequently his diurnal motion describes a parallel which is south of the equator, and which is every day more and more distant from the equator as his place in the heavens, for every succeeding day, is more distant from the equator, and the diurnal motion must be in a parallel drawn from that point. This is the sun's southern declination; and, as he had continued the declination north for three months, this to the south is continued in the same manner, and it is not till about the eleventh of December that the sun is seen in his most remote place south of the equator. It is on this day, therefore, that the diurnal motion of the sun is in a parallel the most distant from the equator of any in which it appears. From this day he begins, as from the day of his greatest declination north, to return toward the equator. His change of place now brings him every day somewhat nearer to the equator, and consequently his diurnal motion is in a parallel that is every day nearer and nearer to the equator for three months more. This is the course of the sun for the winter season; and, about the tenth or eleventh of March, having been as long in returning as he was in declining, he is again in the equator, and his diurnal revolution is performed in that circle; so that he is beginning, from that day, a new declination north as before. All this may very well have, to the ignorant, an appearance of the sun's actually changing place; but, to those who are acquainted with the principles of astronomy, it is very evident, that it is all the while the earth that changes

 place,

place, and that all these changes, in the apparent place of the sun, must be produced by that change.

The sun's place in the heavens is very different as seen from different parts of the surface of the globe. Thus, to all those, who live between the tropics, he is, at times, absolutely vertical, that is, over their heads. This happens twice every year to the inhabitants of all those places under the equator; it is on the thirteenth of March, and on the twelfth of September, that this happens. In other places it is in respect to their latitude and the sun's declination.

There is also this singularity in regard to the sun's place with respect to those who live within the tropics, that the sun, at noon, is sometimes north, and sometimes south, with respect to them. Whenever the sun's declination is greater than the latitude of the place, it is seen to the north at noon; and, on the contrary, whenever the declination is lesser than the latitude of the place, he is seen to the south at noon. This is what happens in change to all the parts of the earth between the tropics, because the sun, in passing to the tropic from the equator, and afterwards in passing from the tropic to the equator back again, is, in its way, at different times, more and less declined than the place answers to in latitude.

This is the case with respect to the sun's place in the heavens with all who live within the tropics; the sun is, at different times, seen at noon, north, south, and vertical; but it is much otherwise with respect to those places which are out of the tropics. In these the sun never can be vertical, for it never can be vertical to any place except it be in a parallel on the earth correspondent to a parallel in the heavens, and consequently it can never pass their zenith from north to south, or from south to north, but on which side soever it is seen, at one time, it is seen always. Thus, whatsoever place is north of the tropics, has the sun always south at noon, and whatsoever place is south of the tropics, has the sun north at noon, and, in neither the one nor the other, can it ever come to their zenith, and therefore it can never change its situation in this respect, since that is only done by getting beyond that point of the heavens, which is the zenith of the place.

SUN, *its apparent Motion and Distance.* When we have determined the true and apparent motion of the sun round about the earth, we shall have found that it is not uniform; but is faster or slower, and that according to the different situations of the sun in the ecliptic. This inequality of the sun's motion has been remarked, by comparing the observations of the sun's meridian altitude to be near to the equinoxes, by which it has been found, that, in the interval of an hundred and eighty-six days from the twenty-first of March to the twenty-third of September, the sun's motion in longitude had been one hundred and seventy-nine degrees, twenty-eight minutes, thirty-three seconds, less, by forty-eight minutes and sixteen seconds, than in the interval of one hundred and seventy-nine days from that twenty-third of September to the twentieth of March following.

This is a consequence of absolute and determinate observation, but, without this, we may immediately observe this inequality of motion in the sun without the assistance of any instruments, only by observing the point of the horizon at which the sun rises on the day of one of the equinoxes, and counting the interval of days which have passed between that time and his being seen to rise, as nearly as may be, in the same place at the succeeding equinox.

equinox. For, although the ſun goes to an equal diſtance from the points of the equinox to the north and to the ſouth, in approaching the tropics of Cancer and of Capricorn, it is eaſy to perceive, that, from the point of the vernal to the point of the autumnal equinox, the ſun is eight days more in the courſe, than he is in going from the autumnal to the vernal.

This ſimple and eaſy obſervation brings us to the ſame point with the other, which is to a proof that the motion of the ſun, with reſpect to the earth, is not uniform. Many hypotheſes have been found to explain this ſingular phœnomenon. Some have ſuppoſed the ſun's motion to be in a circle, ſome in an ellipſis, and others in curves of other kinds.

It has been obſerved, that the apparent inequalities of the ſun's motion were very nearly the ſame in the ſame parts of the ecliptic after an interval of ſeveral years. From hence many aſtronomers ſuppoſed that the orbit of the ſun was circular, and that the apparent inequality of its motion was cauſed by the different diſtances of the earth from the ſun, which they ſuppoſed deſcribed its motions about a circle, the centre of which was diſtant from the centre of the earth. If this could have been allowed, all was eaſy: for, in this caſe, although the ſun actually ran through equal parts of his orbit, in equal ſpaces of time throughout the whole year, yet it would appear to move with different degrees of ſwiftneſs, according to his different diſtances from the earth, quicker when nearer, and ſlower when more remote. It has extremely puzzled the aſtronomers, who adhered to this ſyſtem, to faſhion their accounts.

Ptolemy placed the ſun between two circles, to the inner of which he approached in his perigee, or that time when neareſt to the earth, and to the outer in his apogee, or time when he was fartheſt from the earth. The aſtronomers who followed him, and who would underſtand the orbit to be circular, yet gave up this point, as it appeared obſcured, to place any revolving body in an orbit, the true centre of which it did not make, they had recourſe to many expedients to evade ſo glaring an abſurdity. Copernicus repreſented the periodical motion by an excentric and an epicycle; Tycho Brahe by one concentric circle and two epicycles, and this Longomontanus followed; and Lanſberg tried to explain the apparent inequality of the ſun's motion by a little circle, upon the circumference of which he made the centre of the excentric to move.

Such will be the conſequences of taking up a firſt wrong principle: there is no end of the confuſion; error grows upon error, and the farther the attempt is carried, the farther is the attempt off the mark. The whole of theſe complicated errors aroſe from people perſiſting in the opinion that the motion of the ſun was circular, or in a circular orbit. This could not be made to agree with the different ſwiftneſs and ſlowneſs of his motion without all theſe expedients, nor indeed by them. We ſee every man of ſcience diſcontented with the labours of the beſt, expedients growing upon expedients, and nothing nearer to the truth.

The ſun's orbit is not circular; this is evident from the inequality of his motions. This is the true principle to be given, and, inſtead of labouring to make a circle anſwer to the appearances, they ought to have been convinced, by the appearances, that a circle could not be the figure, and to have enquired what it was. Kepler fell into this more rational method of enquiry, and the reſult of his firſt obſervation was, that the ſun did not move in a circular, but in an ellipſis, or oblong round, and this, or ſomething like this, has been received

ceived ever since his time, and is the truth. In the course of this enquiry, we speak in the ordinary terms of the sun's motion; what is meant is the earth's motion, that is, truly the earth, and not the sun, that moves, would indeed be proved, did there want other proofs even from this observation, for it is not only with regard to the sun that an elliptic orbit is necessary to be established, but the motions of the planets require it.

The old hypotheses of the sun and planets moving about two circles at a time, being too complicated, and at the same time not being sufficient to explain their several apparent motions, which are such that the apparent acceleration of the motion is nearly double to the apparent augmentation of their diameter. Astronomers of later time have distinguished the inequality, which is observed in the motion of the planets, into two parts, nearly equal, the one of which has its cause very different from that of the other. The one they call optical, or apparent, and determine that it depends upon their different distances from the earth, or the sun; and the other physical, which impresses on them a motion more quick when they are nearer, than that they have when they are farther off from the earth, or the sun, and this they determined to be nearly proportioned to the augmentation and diminution of their apparent diameter.

Thus much, though it may seem digressive from the immediate subject, is necessary to its explication: the several parts of this system depend, in such a manner, on one another, that the same laws hold good with regard to them all, and the explaining one, corroborates the explanation of the rest, and receives reciprocal advantage from them.

Now to explain this inequality, two several systems, or hypotheses, have been invented, but both on the same foundation. The original one was invented, as before observed, by Kepler, and still does honour to his name, being distinguished by it; the other is an improvement on his, and from its greater ease and perspecuity is called the *simple elliptic system*. The equations of the planets are calculated, with a great facility, by this; and it has this farther advantage, that those equations may, according to its rules, be determined with a geometric exactness, which cannot be done by the original system of Kepler.

Kepler, when he has proved the insufficiency of all the hypotheses which made the motions of the planets circular, to account for their motions and appearances; having adopted the opinion of the sun's being the centre of the universe, supposes that luminary to be placed, not in the centre of a circle, but in the focus of an ellipsis, round about which the planet performs its revolution, in such manner, that the arc, as comprised within the several arcs, which it describes, and the rays drawn from the sun to the planet, should be proportioned to the times which the planet takes to go over those several arcs; that is, supposing the sun to be placed at one of the focus's of an ellipsis, and the earth on the circumference of that ellipsis, is moving from one given point to another; the time which it employs to make its entire revolution, shall be to the time which it takes to run from one of these points to the other, as the whole area, or surface of the ellipsis, is to an area; and supposing it to be again moved to another given point farther distant, the time which it employs to go through that arc, shall be to the time which it took to go through the other, as the measure of one of those arcs is to the other.

Such were the principles of Kepler, and he deserves all the honour that has been done him as the eftablifher of them; but as the method which he had laid down of determining the equations of the planets, on this foundation, is long and troublefome, many of the fucceeding aftronomers have devifed, and publifhed other methods more eafy, and better for practice; this, however, could be only done by approximation; for as the bufinefs is to calculate the area of a fector, formed by two right lines, and determinated by an arc of an ellipfis, the geometrical revolution of the problem fuppofes the quadrature, or fquaring of the ellipfis, which is hitherto as much unknown as the fquaring of the circle; fo that all who have laid down whatfoever manner of calculating the equations of the planets, according to this hypothefis, have confeffed, that it is only to be done by approximation, and pretend to nothing more than the doing it as nearly as is neceffary for aftronomical calculations. Gregory has given one of thefe methods, and De La Hire, of the French academy, another: Keill has alfo publifhed one on the Newtonian principles, in the philofophical tranfactions, and the younger Caffini a better than any of them, with memoirs of the academy of Paris 1719. This is a very familiar one, and by it we determine, for each degree of mean anomaly, the true place of the planet, according to the hypothefis of Kepler.

But there is yet another confideration, an hypothefis, which is different from all thefe, and which the world owes to the elder Caffini. This does not allow the earth's orbit, or, to ufe the ordinary phrafe, the fun's motion, to be in a circle, according to Ptolemy, and his followers, nor in an ellipfis, according to Kepler, but in a curve different from both. The hypothefis was founded upon a moft exact feries of obfervations of the apparent bignefs of the diameters of the fun.

He fuppofes, that the earth being placed at one of the focus's of this curve, the fun runs round it by his proper motion, and that in fuch a manner, that drawing two right lines from its centre to the two focus's of the curve, at one of which the earth is placed, the rectangle made upon thefe right lines, fhall be always equal to a rectangle made upon the greateft and the leaft diftance of the fun from the earth.

The equation of the fun which anfwers to a given anomaly, according to the hypothefis of Kepler, will be fo near to that, produced by working on the principles of this curve, that the difference will not be fufficient to make any uncertainty worth notice in aftronomical calculations; fo far they fupport and ftrengthen one another; but the greater precifion by far will be found in this method of Caffini's. *For farther explanation of what regards the fun, fee the articles* Days, Apogee, Perigee, Obliquity *of the Ecliptic, and* Magnitude *of the Sun.*

SURFACE. Aftronomy adopts this term from the mathematics, and employs it to exprefs quantity, or, more determinately fpeaking, that fpecies of quantity which we call magnitude, when it is extended in length and in breadth; but is not fuppofed to have any depth, or thicknefs. A furface is defcribed by the out-line which marks the upper, or the under, or any one of the fide faces of a folid; it is formed of a line, extended more or lefs in breadth. When we would put down the figure of a line, we exprefs whether we will or not. A furface line, in the mathematical fenfe, is an ideal exiftence; when we would mark it upon paper, in order to render it vifible, we give it that breadth

which

which does not belong to it, and we convert it into a ſurface, for a line is quantity, extended in length, without any breadth at all. By a ſurface we underſtand the ſimple extent of any thing in length and breadth without depth. The ſhadow of any ſolid body, as it is extended upon the ground, is properly, and only a ſurface; for it has no thickneſs, although, in length, and breadth, it repreſents the body to which it is owing. When I meaſure a pond, or a canal, as to its length and breadth, without taking any notice of its depth, it is the ſurface of that pond, or, in other words, it is a ſurface that I meaſure.

This is the ſenſe of the word ſurface, when taken in its general meaning; but as this definition does not exclude inequalities in it, and as without connecting any ideas of thick, or thin, of high, or deep, we may conſider a ſurface as plane, as elevated, or depreſſed, or flat, riſing, or ſinking ſurfaces, or ſuperficies, in mathematics and aſtronomy, are deſigned by different forms, and diſtinguiſhed by different names.

When the ſurface is perfectly flat, or even, as that of a table, a looking-glaſs, or a ſlab of marble, it is ſaid to be a plane ſurface, or is called a plane.

When the ſurface riſes, or ſinks in it, it has alſo its appropriated denomination; if it riſes up like that of a ball, it is called *convex*; if it ſink in like that of a cup, or baſon, it is called a concave ſurface, and often the word ſurface is left out, and only the adjective uſed; the expreſſion then is a *convex*, or a *concave*.

The extent of a ſurface, like that of a line, is arbitrary. In viſible objects, in general, we ſee it circumſcribed by the out-line which marks any one of their faces; but as ſpace has no bounds, we may imagine a plane ſurface, extended every way without limits, and this is what is called an indefinite, or, in leſs appropriated words, an infinite ſurface. When we ſpeak of ſurface, under this general ſenſe, we do not underſtand it as every way terminated and encloſed; for then, although it continue to be in itſelf ſurface, as before, yet, by the circumſcription of thoſe lines, it obtains a new name from the connection with them, and is called a figure.

SYNÆCI. A term, uſed by the old aſtronomers and geographers, to expreſs people living in part of the earth when the horizon was the ſame. When two places were ſo near to one another, that there was no obſervable difference in the horizon, and that, in conſequence, the length of days, and the times of the ſeveral ſeaſons of the year were the ſame, the people who inhabited theſe places were called neighbours, or, ſuch as lived together, Synæci. The term was uſed in diſtinction from thoſe people whom they called Periæci; theſe were ſuch as had in different parts of the ſame parallel, and conſequently had the ſame kind of days and nights, but at different hours, or who lived in the oppoſite points of the ſame parallel, for there are ſome who reſtrain the latter term to that ſenſe only, and conſequently have it noon at one of them, at the ſame time that it is midnight in the other, a neceſſary conſequence of their being oppoſite, and yet at the ſame diſtance from the equator. The antients had many terms of this kind, and they ſerved a very good purpoſe in that they joined aſtronomy and geography together.

SYNODOS. A term that frequently occurs in the old Greek aſtronomers, and expreſſes a conjunction of any one of the heavenly bodies with any other. but it is more particularly uſed to expreſs what the aſtrologers call the principal of their aſpects, which

is

is the conjunction of one of the planets with one of the conſtellations, to which they ſuppoſe it has ſome natural reſemblance, or with ſome particular fixed ſtar, to which they alſo ſuppoſe it to have the ſame affinity.

SYSTEM OF THE WORLD. In order to explicate the diſpoſition and arrangement of the ſeveral parts of the univerſe, and to ſhew in what manner the celeſtial bodies move with regard to one another, and with regard to this earth which we inhabit, men have, from time to time, laid down certain hypotheſes and ſyſtems, which they have called ſyſtems of the world. There have been ſeveral of theſe different in the wideſt degree from one another; they began very far from truth, and as ſcience improved, they, by degrees, come nearer and nearer to it, unto the preſent eſtabliſhed one, which there can be no reaſon to doubt will laſt as long as that world which it explains, ſeeing, that it is beyond a doubt the truth. It is odd to ſee how many different ways people have found to explain the ſame appearances, for they were the ſame to all.

Some have imagined, as it appears at firſt ſight to the ſenſes, that this earth we inhabit was placed in the centre of the univerſe, and they have imagined, that the ſun and ſtars did, in reality, perform ſeverally their revolutions round this globe, not only the diurnal, which is from eaſt to weſt, but alſo the general courſe that they all take at a longer period, and which is, on the contrary, from weſt to eaſt. The firſt, or the diurnal motion, they ſuppoſed to be common to them all, and the latter to be peculiar to each.

Others, on the contrary, have placed the ſun in the centre of the univerſe; they have made that the ſole immoveable body, and they have laid it down, that the planets, and this earth itſelf alſo, made their revolutions about that body. Theſe have underſtood alſo, that what appeared to be a diurnal revolution of all the heavenly bodies round about the earth, was no other than a motion in the earth itſelf, a revolution round its own axis, which it accompliſhes in twenty-four hours, and in a direction contrary to the apparent motions of all theſe from weſt to eaſt. The firſt of theſe opinions was the moſt natural for thoſe to embrace, who judged only by appearances, as they took them at firſt ſight, the latter could only ariſe from diligent enquiry, and a ſecond judgment; the firſt therefore was natural to be eſtabliſhed in the leaſt improved times, and the other after the cultivation of ſcience.

The ſyſtem which eſtabliſhed the immobility of the earth, has been explained two ways by Ptolemy, and by Tycho. The other ſyſtem which makes the ſun immoveable, and our earth, as well as the planets, in general, to turn round it, is not ſo modern a thing as many may imagine. It is evident, that Ariſtarchus propoſed it as his opinion, and that Philolaus, and many of the old philoſophers beſide, received it. This had, however, been overborne by the other ſyſtem, which had appearance, and the prejudice of the vulgar, on its ſide, till it was adopted and received by Copernicus. This great man formed out of it a regular ſyſtem, which Kepler, and after him the modern aſtronomers, in general, have received; this is the ſyſtem at this time received, which has had the improvement of Sir Iſaac Newton, and has his name for its ſanction, and will undoubtedly remain for ever. No one doubts now but the ſun ſtands ſtill in the centre of the univerſe, and this earth, and the other planets, for this earth is no other than a planet, turns round it. *But as theſe ſeveral ſyſtems may be a ſubject of enquiry,*

enquiry, they are explained in their places under the names of their inventers, and will be found in the proper articles. See PTOLEMAIC SYSTEM.

SYZYGY. A term uſed by ſome of the Greek writers to expreſs what our aſtrologers mean by their term aſpects, that is, as they have explained themſelves, certain mutual irradiations of the planets and conſtellations, or ſingle fixed ſtars on one another, in conſequence of which they were ſuppoſed to cooperate together. There were five of theſe aſpects; the conjunction, when the planet and ſtars were together; the ſextile, when they were at ſixty degrees diſtance; the quadrate, when at ninety; the trine, when at an hundred and twenty, and the oppoſition, when at an hundred and eighty. Some will have only the conjunction to be expreſſed by this term Syzygy, and it is plain, that it is uſed, and properly, to ſignify conjunction on other occaſions; but the oldeſt writers uſe it to expreſs aſpect in general.

T.

TARAN, *or* TARARNIS. A name by which we find the planet Jupiter called in ſome writers of our own country, but they are ſuch as do not, however, deſerve to be much read. Nothing can be ſo idle as the affectation of uſing uncommon words for names of things, of which there are enough that are common. This is a Tartaric name for the planet.

TESTUDO. A conſtellation offered to the aſtronomical world in the plates of this work, and compoſed of certain conſpicuous and unformed ſtars over the conſtellation Cetus; it is not a very large one, but for the ſpace it occupies in the heavens, it comprehends a conſiderable number of ſtars. The figure under which it is repreſented is that of a tortoiſe, drawing up its legs within, or nearly within the ſhell, and ſtretching out its neck, a common poſture with that ſlow animal, when apprehenſive of danger. The conſtellations between which the Tortoiſe is placed, are the Whale, the Fiſhes, and the water of Aquarius; there is left a vacant ſpace in the heavens between theſe, and this is very happily occupied by the figure; it ſeems crawling over the tail, and toward the back of the Whale. The two fiſhes are carried almoſt parallel over its back, and its tail is pointed toward the urn of Aquarius, it is in its hinder part, very near one of the fiſhes, but at a greater diſtance from Aquarius, and it is toward the head, very near the Whale.

The conſpicuous ſtars in the conſtellation Teſtudo are twenty-ſix. Six of theſe are in the head, five in the tail, and three in the fore, and two in the hind foot; and the reſt are diſtributed over the body. Of thoſe in the head, there is one at the extremity, and two near the upper out-line; there is a ſingle ſtar near the inſertion of the neck to the ſhell, and there are four toward the anterior part, and five toward the hinder part of the ſhell; one of theſe laſt is almoſt loſt by being cloſe to a larger. In the fore paw there are three, two of theſe very cloſe to one another, and the other at a diſtance, in the hinder foot one of the two, the anterior one is a large and bright ſtar, and the others is equal to moſt of the others. Of the five at the tail, one is very near its inſertion to the body, and the other four are very near its extremity, and near to one another; theſe are at a ſmall diſtance from the lower fiſh.

TETRAGONOS. A term which we meet with in the Greek authors, and which is uſed to expreſs one of thoſe aſpects that the planets and conſtellations, or planets and fixed ſtars, are underſtood by the aſtrologers to have particular power when they are found in them. It is the ſame with what the Latins called the quadrate aſpect, and it ex-

preſſes that relation which they ſtand to one another when they are a fourth part of the circle, or, in other words, ninety degrees diſtant from one another.

TOUCAN. One of the new conſtellations of the ſouthern hemiſphere. It is not to be met with in the writings of the antients, being one of thoſe which the late aſtronomers have added to the old forty-eight. It is but a ſmall conſtellation, and it does not contain a quantity of ſtars at all proportioned to the ſpace which it occupies in the heavens.

It is repreſented very well according to nature in the ſchemes of the heavens, but the bird, which it is deſigned to expreſs, is ſo very ſingular in its proportions, that it may be eaſily ſuppoſed a creature of imagination, by thoſe who are not enough acquainted with natural hiſtory to know that there is ſomething of the kind in nature. It is a bird of no great bigneſs, and is figured in a poſture of ſtanding, with the wings cloſe to the ſides, and is a bough of ſome tree in its mouth, the head enormouſly large, and the beak very nearly equal to the whole body in bigneſs, they ſomewhat even proportion the head, but the beak is, in reality, of this amazing bigneſs, and yet, being hollow, it is ſo light that it is no encumbrance to the animal. They have done ill who have called the conſtellation, in Engliſh, the American Gooſe, for the Toucan is not at all of the gooſe kind. It uſed to be called, though not with perfect propriety, the Braſilian Magpye; it is indeed of a genus different from both.

The Toucan is placed in the heavens between the Phœnix, the Indian, the Crane, and the Hydrus. The pedeſtal, on which the Phœnix is repreſented ſtanding, comes, at one end, very near to the back of the Toucan. The legs of the Crane come alſo very near to its head, its back, at the extremity, is but a little diſtant from the thigh of the Indian, and the head of the Hydrus is almoſt cloſe under its tail. There is a ſpace among theſe conſtellations which it fills very happily, except that, toward the body of the Hydrus, there is a ſpace between that and the feet of the Toucan.

The ſtars, compriſed in this conſtellation, are only nine, nor are they the moſt happily diſpoſed. People, who had nothing to conſider but a figure under whoſe out-line theſe would beſt ſtand, might have fixed upon that of ſome other creature, under whoſe form they would have been placed more advantageouſly. There is one in the head called the eye of the Toucan, another toward the extremity of the back, and one in the bough in its mouth. On the breaſt there are three ſmall, but very diſtinguiſhable, ſtars, nearly in a line, and there are two larger, the one on the belly, and the other on one of the wings; and a little lower than theſe, there is a ſingle ſtar upon the lower part of the belly between the inſertion of the two thighs. By the diſpoſition of theſe it will appear, that they have as little conformity in their figure to that of the bird, as the ſtars of the wildeſt-fancied among the old conſtellations, in which there was propriety and meaning to make amends for the want of regularity in the ſituation. Moſt of the new-formed conſtellations are better ſuited to their ſtars than this.

TRANSIT. A term uſed to expreſs the paſſage of any of the heavenly bodies, the ſun, a fixed ſtar, or a planet, over the meridian. The obſervation of this is of almoſt univerſal importance, and it is very eaſy. A meridian may be found, in a very familiar manner, thus. On the day of the ſummer ſolſtice erect a braſs wire upon an horizontal plane, obſerve

when

when the ſhadow falls at two o'clock in the morning, mark the place, and draw a circle, the out-line of which cuts that point. Watch the ſhadow in the afternoon, and ſee when it touches the circle again. This will be in a part diſtant from that in which the ſhadow touched it in the morning. Mark this point alſo, and, drawing a line from the centre of the arc, intercepted between theſe two points, to the place where the wire is erected, this will be a meridian line.

The obſervation, by this line, is not leſs eaſy than the conſtruction of the line itſelf. Two threads are to be ſuſpended exactly over it at a little diſtance from one another, and with plummets at their ends to keep them ſteady. Theſe two threads, being thus in the plane of the meridian, when the edge is ſo ſituated as to take in both as one; that is, when it is ſo placed, that, being near one, the other is covered by that, a ſtar, viewed in this direction, will be known to come to the meridian by the threads being immediately before it. Whatſoever heavenly body is ſeen to paſs behind the two threads, the eye thus ſeeing them one, is ſeen to paſs the meridian, and the moment when the threads are in the centre of the object, is the moment of its tranſit. If it be a ſtar, this is all that is neceſſary, but, if it be the ſun that is to be obſerved, there is to be a piece of ſmoaked glaſs between it and the eye, to prevent injuring the ſight, and the moment when the ſun paſſes over the threads with its centre, is the moment of its tranſit over the meridian. There is a more accurate way of viewing them than this, whether they be the tranſits of the ſun, or of the ſtars. In this method a teleſcope is to be uſed inſtead of the two threads; the teleſcope is to be placed in the meridian, and two croſs hairs are to be extended over the eye-glaſs, one in an horizontal, and the other in a vertical poſition, through this teleſcope, the ſtar, or planet, or whatever other of the heavenly bodies is to be viewed, and when the centre of the object falls upon the vertical hair, then that object is at the meridian. This is the more accurate way, but the other is, in general, ſufficient.

In the ſame manner it is that the elevation of the pole is found for any place, by an inſtrument fixed in the plane of the meridian. To this purpoſe, nothing more is neceſſary than to take the greateſt and the leaſt height of ſome ſtar which is within the arctic circle of that place. Whatſoever ſtar is within this circle never ſets, but is carried in a parallel that is, in every part, above the horizon, ſo that, inſtead of riſing in the eaſt, and ſetting in the weſt, at right angles, or obliquely, as is the caſe in a right or oblique ſphere, it only riſes gradually from its loweſt point, and, when it has riſen to the meridian, gradually deſcends to its loweſt point again. Such a ſtar being choſen, nothing more is to be done than to find its greateſt and its leaſt height, and, when that is done, to take the middle between both, for that middle is the height of the pole in that place. But even this is not neceſſary, for, to the aſtronomer, who is accuſtomed to celeſtial obſervations, one ſtar, once obſerved, will anſwer the purpoſe. Let the declination of the ſtar, which is pitched upon, be known, and this is to be found in the tables of declinations, and then nothing more is neceſſary than the obſerving the ſtar in the meridian; the ſtar's diſtance from the pole being taken from its greateſt height at the meridian, the remainder is the height of the pole. In the ſame manner alſo, and on the ſame principle, the height of the pole is to be taken, by obſerving the leaſt height of the ſame ſtar, that is, the height which it has in the loweſt point of its apparent motion, or, in

that point of its parallel, which, although in ſight, may be called its oppoſite meridian. When his height is taken at the diſtance of the ſtar from the pole was to be taken away from its greateſt height to give the elevation of the pole in the place, ſo the diſtance of the ſtar from the pole is to be added to its leaſt height, and this, in the ſame manner, gives the height, or, as it is generally called, the elevation of the pole for the place. In this reſpect, however, a caution is to be obſerved, that the ſtar, which is choſen for the obſervation, be not one of thoſe at, or very near, the verge of the arctic circle, for, in that caſe, its leaſt height being in a place very near the horizon, the obſervation will be ſubject to errors from the refraction: and, in general, it is to be obſerved, that obſervations of ſtars, with whatever intent, ought not to be made when they are near the horizon, for they will be ſubject to error from the refraction; and not only this, but they will be liable to uncertainty, added to that error, from the variableneſs of that refraction; ſo that, in this caſe, the obſervation is beſt made on a ſtar that is at ſome diſtance above the verge of the arctic circle, and it may be a general rule as to obſervations in general, that, when it can be done, it is beſt to make them at a diſtance from the horizon.

TRIANGLE. This is a plane figure, encloſed by three lines, which meet and form three angles; theſe three lines are called the three ſides of a triangle. If theſe lines are all ſtrait, it is called a plane triangle, if they are curves, it is called a curvilinear triangle, and if they are ſome of one kind, and ſome of the other, the figure is called a mixed triangle. In every plane triangle, an angle may be ſaid to be oppoſite to a ſide, or a ſide may be ſaid to be oppoſite to an angle. Thus, in a triangle ſet upon its baſe, the corner, or angle at the right hand, is oppoſite to the ſide on the left, and the angle at the top is oppoſite to the ſide, which, in this poſition, forms the bottom; and, on the other hand, the ſide on the right hand is oppoſite to the corner on the left, and the ſide which makes the bottom to the corner, or angle to the top. A triangle may have all its ſides, and all its angles, equal, or only two of its ſides, and two of its angles may be equal, or all the ſides, and all the angles may be different.. When one of the three angles is a right one, the whole is called a right angled triangle; when one of the angles is obtuſe, the whole is called an obtuſe angled triangle; and, finally, when all the angles are acute, the figure, what we call an acute angled triangle, theſe are the three great diſtinctions of the plane triangle.

It is a cuſtom to call one of the ſides of a triangle its *baſe:* but this term is not particularly applied to any one of the ſides preferably to the other. The common cuſtom is to call that ſide the baſe on which it ſeems to ſtand in the point of view where we look at it. Thus in turning about the paper on which a triangle is drawn, we make any ſide, or all alternately, the baſe. When one of the ſides is conſidered under the denomination of a baſe, the other two are called its legs.

In every triangle, the three angles taken together are equal to two right ones, this is eaſily proved; for if a line be drawn through the vertex of the triangle, parallel to the baſe, then the two ſides, or legs of the triangle, muſt be conſidered as falling upon theſe two parallel lines, and then the angles formed by the left hand corner of the triangle, and by the upper corner with the right hand, part of the parallel line are equal to two right lines, being interval, oppoſite on the ſame ſide; this is a demonſtration as old as Euclid, and

is fruitful in the useful corollaries. From hence it is proved, that the sum of the angles of any one triangle, is equal to the sum of the angles of any other triangle, that is the whole amounts to one hundred and eighty degrees, or to the sum of two right angles. Hence also we learn, that the quantity, or number of degrees of any one angle of a triangle being known, the quantity of the two other angles may be known; and, on the other hand also, the quantity of two legs of a triangle being given, the quantity of the other angle may be known. Hence also it is evident, that if two angles in one triangle, be equal to two angles in another triangle, the remaining angles are equal; in every right angled triangle, one acute is the complement of the other ninety degrees; if one angle in a triangle be a right one, it is also evident hence, the others must be acute; and, finally, if any right angled triangle has one acute angle equal to one of the acute angles of another right angled triangle, then those triangles are equiangular.

These contain the great doctrine of triangles, and these are the regular result of the before mentioned demonstration. *For the measuring triangles, see the term* TRIGONOMETRY.

TRIANGULUM, *the Triangle.* One of the constellations of the northern hemisphere, a small and inconsiderable one in proportion to many that are about it, but mentioned by all the writers of astronomy, and one of the old forty-eight constellations which the Greeks were acquainted with in the earliest times, and which they probably received from the Egyptians, their instructors in the science. The Greeks are the people to whom we owe the original improvement of astronomy; but it was from the Egyptians that they received the rudiments of it by Thales, and those who succeeded him, and who made it a part of the course of their studies to converse with the Egyptian priests.

There is beside this antient triangle, another constellation of the same name, it is of much later origin, and is in the southern hemisphere, but this is always distinguished by the epithet of place annexed to it, being never named otherwise than under the name of Triangulum Australe, or the Southern Triangle; this will be spoken of hereafter. The constellation of this name in the northern hemisphere, and which is the subject of the present consideration, is very small, but for its bigness it comprehends a proportional number of stars; its figure is that of a triangle, with unequal sides, and it is supposed not to be designed by single lines, as is the case in the marking mathematical figures, but is represented as consisting of three sides, of some breadth, so as to contain in some places two, in others three stars, in a line between the two out-lines.

The constellations that stand about the Triangle are, Andromeda, Aries, Taurus, and Perseus, it stands not in the centre, but toward one edge of a large space which is left among these four constellations, and there are some very unformed stars about it, that it were to be wished some other figure of more extent and variety had been devised for the receiving them. What was the Egyptians meaning for chusing this is not known, but certainly it would have been easy to have found a better; it comes very near to a part of the robe on the left side of Andromeda, near her waist, and is nearly at equal distance from the gorgous head of Perseus, the back of the Bull, and the head of Aries.

The antients counted only four stars in the Triangle; Ptolemy sets down that number,

 T R

and we know he was a clofe follower of Hipparchus, who made the firft catalogue that ever was drawn out, fo far as we are informed from hiftory. Tycho preferves the fame number, and Hevelius has only added to it eight; he makes the number twelve, and our Flamftead has at length encreafed it to fixteen; thefe are none of them of any great fize; there are only two of the fourth magnitude, the reft are of the leffer kind, and principally of the fixth and feventh. The feveral ftars between the Triangle and Aries, are ufually accounted for under the name of the unformed ftars of Aries.

Among the various conjectures that have been made about the origin of this fingular conftellation, fome have fuppofed it, by its original inventors, to have been intended to convey an idea of the figure of their country, the delta, as it is called to this day. Some others, with much lefs fhew of reafon, have imagined Sicily intended to be reprefented by it; but the Greeks always determined to have fome account of their own kind, have told us, that it was a reprefentation of the letter delta in their alphabet, which is of a triangular form, and that Mercury placed it over the head of Aries, in honour to the word Dios, a name of Jupiter. When will people ftop who could go fo far for fable?

TRIANGULUM AUSTRALE, *the Southern Triangle*. One of the new conftellations of the fouthern hemifphere, mentioned by all the late aftronomers, and one of thofe which has been added by fome that have but lately made their additions to the fcience, to the forty-eight old afterifms.

The Triangle is but a fmall figure, and it contains only a very fmall quantity of ftars, thofe are, however, fo happily difpofed, that the conftellation is very well marked, and very eafily known by them. Its figure is that of a triangle, regularly drawn, and its fituation is between the Altar, the Wolf, the Centaur, and the Bird of Paradife. The upper part of the fmoke of the Altar afcends to one of the fides of the Triangle, the Wolf is at a great diftance over the other, and the fore foot of the Centaur comes very clofe upon the farther corner of that fide, the head of the Bird of Paradife is brought very clofe to the other corner, which is commonly called the top of the Triangle, and the head of the Chameleon is oppofite to one of the fides, but at a diftance; it tolerably well fills the fpace between the Altar, the Bird of Paradife, and the foot of the Centaur, but there is a great vacant fpace between one of its angles, and the fign Scorpio.

The ftars which compofe the Southern Triangle are only five; three of them larger, and two fmaller; but all fufficiently confpicuous. If we call that the top of the Triangle which comes to the head of the Bird of Paradife, there is then one of the larger ftars at, or near the top, for this ftar is near the head of that bird; there is alfo another of them at that angle, which is near the foot of the Centaur which ftands down, and the third of the larger is without fide, which runs from that angle to the other, which points toward the tail of the Scorpion; the two fmaller are in the fides, one of them in the fame fide with the laft mentioned of the three large ftars, and placed between that, and the fecond, but nearer to the fecond; the laft is in the lower part of that fide, which reaches from the top to that corner which is oppofite to the tail of the Scorpion. In the whole, partly by the difpofition of the ftars, and partly by the place of the conftellation, for it is on all parts, except toward the Scorpion, fo well encompaffed with others, that there

there is no room loſt. The Southern Triangle is as eaſily diſtinguiſhed as any conſtellation.

TRIGON. A name of one of the famous aſpects of the planets and fixed ſtars among the antient aſtrologers; it is the ſame that is called alſo the Trine, or Trine Aſpect; it is that into which they fall when they are at the diſtance of a third part of a circle, or are one hundred and twenty degrees from one another.

This is the moſt famous of all the planetary aſpects, and refer to the zodiacal ſigns, according to the wild opinion of the early times, with regard to which theſe Trigons were diſtinguiſhed by peculiar epithets. Thus they ſuppoſed the twelve ſigns of the zodiac to be of the nature of the four elements, three of them referring to each element. They called Aries, Leo, and Sagittary, the three fiery ſigns; Gemini, Libra, and Aquarius, are the three airy ſigns; Cancer, Scorpio, and Piſces, the three watery ones; and the earthy are Taurus, Virgo, and Capricorn. It was according to the aſpect of any of the three ſuperior planets, with reſpect to theſe particular ſigns, that the Trine, or Trigon, received its peculiar denomination. If the relation was between the planet, and the three firſt, or any of them, then it was called a fiery Trigon. If with any of the three ſecond, the reſult was what they called an airy Trigon; if with any of the third, there was formed an aquatical Trigon, and if with any of the three laſt an earthy Trigon; theſe were the diſtinctions, and from theſe the aſtrologers preſumed to pronounce the fate of kingdoms, and to foretel the events of a man's actions; and hence has ariſen all that jargon with which the books of aſtrology are loaded, and by which fools have been deluded.

TRIGONOMETRY. The mathematicians and geometricians have reduced the meaſuring of triangles into a regular and diſtinct art, and they have called it by this name Trigonometry. The ſubject of this art is the finding the quantity of every angle of the figure, and the length of every ſide of it, or elſe it is ſimply the calculating what is the area of the Triangle, or the ſpace comprehended within the lines which mark that figure.

In the conſideration of a triangle, there offer to the view ſix parts, three angles and three ſides; and Trigonometry, beſide the common and eaſy method of finding the extent and quantity of theſe, teaches us, how, if ſome of theſe are given, we may find out all the reſt. This is a point of more difficulty, and of the greateſt uſe.

TRINE. A famous term among the aſtrological writers; they call it alſo Trigon, and, by way of diſtinction of its ſeveral peculiar differences, add the epithet of the fiery, the watery, and the earthy Trigon, or Trine.

The Trine is one of the five aſpects of the old aſtrologers, it expreſſes that ſituation of a planet and a fixed ſtar, or a planet and a conſtellation, with reſpect to one another, which they hold when at a third of a circle diſtance, or when they are one hundred and twenty degrees from one another. Trinus is the Latin, and Trigonos the Greek name, but they are uſed by the Latins indiſcriminately. The notions of fiery, watery, and earthy Trigons, have been already explained under the word Trigon. The other aſpects, under which the planets and fixed ſtars were ſuppoſed to have peculiar influence with reſpect to human affairs are four, they are the Conjunction and Oppoſition, the Sextile and the Quadrate. In the Conjunction the planet and fixed ſtar, or

ſtars,

ſtars, are together; in the Oppoſition they are juſt half the circle diſtant; in the Sextile they are ſixty; and, in the Quadrate, or quarter of the circle, or ninety degrees aſunder. In all theſe ſituations, they are ſuppoſed to ſhed mutual influence, and dart mutual radiations upon one another, and to have a peculiar power over human affairs. This is ſtrange nonſenſe, but, while we deſpiſe the meaning, we muſt underſtand the terms.

TRIPLICITIES. A term that we find in the writings of thoſe old aſtronomers who have favoured judicial aſtrology: it is uſed to expreſs certain aſpects, as they are called, of the planets and fixed ſtars in the conſtellations, to one another. They had five of theſe aſpects, or, as they otherwiſe called them, conſpects or ſyzygies, in which they ſuppoſed that the planets and the ſtars ſhed a mutual influence, or ſent reciprocal radiations toward one another, and that they, at theſe times, co-operated to the forming and modelling of future events; this was their wild and idle ſyſtem. Among theſe aſpects, thoſe, which were called triplicities, were the moſt regarded, and ſuppoſed the principal of all the five aſpects were, the Conjunction, or Synodus, when the planet and the conſtellation were together; the Sextile, or Hexagonus, when they were at ſixty degrees diſtance; the Quadrate, or Tetragonus, when they were at ninety degrees; the Trine, or Trigon, when they were at one hundred and twenty degrees; and the Oppoſition, in which they were at half a circle, or one hundred and eighty degrees diſtance. But, of all theſe, the moſt famous, and, as it was pretended, thoſe which preſaged not only the greateſt events, but preſaged them the moſt certainly, were the Trigons, or trine aſpects; and when theſe were made by conjunctions of any one of the three ſuperior planets with the ſigns of the zodiac, they were called by this name of Triplicities, and were the moſt powerful, and the moſt regarded of all. They divided the conſtellations of the zodiac into four ſets, the fiery, the airy, the watery, and the earthy; the firſt were Aries, Leo, and Sagittary; the ſecond conſiſted of Gemini, Libra, and Aquarius; the third took in Cancer, Scorpio, and Piſces; and, into the fourth, came Taurus, Virgo, and Capricorn. The aſpect of a ſuperior planet with any one of theſe, at the diſtance of one hundred and twenty degrees, formed what was called one of the Triplicites, or greater Trigons; and, according to the denomination of that arrangement under which the aſpect fell, it was called a fiery Trigon, an airy Trigon, and a terreſtrial Trigon. This was the doctrine of thoſe times, and, idle as it was, it is amazing to conſider how many ages it continued in credit.

TWINKLING *of the fixed Stars*. Among the many diſtinctions of the fixed ſtars from the other luminaries of heaven, that which their light, or peculiar kind of luſtre, affords, is the moſt obvious.

The aſtronomer, when he has gone but a very little way in the ſtudy, will find, that the order and arrangement, the ſameneſs of ſituation which the fixed ſtars preſerve with regard to one another, is ſufficient to diſtinguiſh them at ſight from the planets, and comets, which are continually, and very ſwiftly, changing their ſituation with regard to the reſt of the heavens; but even the unread in this ſcience will, by the mere eye-ſight, diſtinguiſh the fixed ſtars from the others by the difference of their light. The planets appear of a more full light, becauſe they are infinitely nearer to us, and this light is ſteady, like that of the moon, becauſe it is reflected

in the fame manner, and is not innate, but that of the fixed ftars is more bright and lively.

When we direct our eyes to any of the fixed ftars, but efpecially when we make any of the largeft the objects of the obfervation, we perceive, as we look attentively on them, a kind of vibration of light, which we term twinkling, This is peculiar to the fixed ftars, and it is more or lefs in all of them, even the leaft, the light of the planets being fteady. The two indeed which are neareft to the fun, Mercury and Venus, have fomething of this twinkling in their light, but it is inconfiderable in comparifon with that of the leaft of the fixed ftars; we fee nothing of it in the three more remote planets, Mars, Jupiter, and Saturn; and, what is yet more fingular, we diftinguifh nothing of it in the comets, their light being, in general, more fteady, as alfo more faint, than that of the planets.

We receive it as a principle, that the fixed ftars are placed at an immenfe and inconceivable diftance from the fun, and it is proved, by experiment and obfervation, that they are fo. The Copernican fyftem, in a great meafure, refts upon this, and, when it appeared too much for credibility in the mind of Tycho Brahe, he oppofed a fyftem to anfwer to appearances without it, and that fyftem is found a falfe one. The immenfe diftance of thefe bodies from the fun being thus fully proved, when we fee them fhine with a light more bright and fparkling, we cannot but allow that they have the fource of their light in themfelves, and that they do not borrow it, as the planets do theirs, from the fun, for, if they did, it would be feebler, as more diftant.

There are, indeed, among the number of the fixed ftars, feveral which are very fmall, and fome which we call nebulous, the light of which has lefs of this vivacity and twinkling, and that of the latter kind fcarce any, except to the eye of a very experienced obferver. Thefe might, if we judged of the nature of the ftars by their light above, be fufpected as not of the fame nature with the reft; but, when we fee them agreeing with the fixed ftars in keeping their exact and invariable fituation with regard to one another, we cannot omit to account them of the nature, and of the number of the fixed ftars, and we fuppofe the feeblenefs of their light to be owing, not to their being different in their nature from the others, but to their being at a greater diftance, for we know, by experiment, that diftance will diminifh the light of objects as much as their apparent diameter. It is the prefent opinion, and it is an opinion that does honour to the Creator of the univerfe, that all the region of unbounded fpace is fet with ftars and worlds; if it be fo, it muft needs appear, as it does to us among the fixed ftars; thofe, which are neareft to the earth, are, we know, remote in an immenfe meafure, but, on this fyftem, there muft be others more and more remote, and thefe muft appear not only fmaller, but with a feebler light, in proportion to their diftance. We find it fo on the view, the largeft ftars are the brighteft; in gradation from thefe, we fee, in the concave of the heavens, others fmaller, and, in proportion, lefs bright, down to thefe minute ones.

Aftronomers diftinguifh them under feveral feries, as, of the firft, fecond, and lower magnitudes, and what farther countenances this fuppofition, is, that the ufe of glaffes difcovers more; a telefcope, directed to a part of the heavens, where, to the naked eye, there appear no ftars, will difcover feveral, and it fhould feem, nay, it is palpable, that, as there are multitudes of them more remote than the reft, and therefore not fo large to our eyes, fo, beyond the diftance and fmallnefs of thefe, there are others quite imperceptible to our

eyes, becauſe yet more diſtant. As we find the light, in general, decreaſe in brightneſs with the encreaſe of diſtance, or decreaſe of magnitude in the ſtar, for theſe are reciprocal, we are not to attribute the fainter light of the ſmalleſt, that are ſeen by our naked eye, to their different nature, but to their different diſtance. As to thoſe which are called nebulous ſtars, we know at this time, by the help of better teleſcopes than the firſt obſervers of them had, that they are not ſingle ſtars, but each of them is a cluſter of ſeveral ſmall ones, ſo that, although their diameter appear equal to the larger kinds, their light ought to be as weak as that of the leaſt, ſince this is proportioned to the ſingle ſtars of which the cluſter is compoſed.

Theſe are the general obſervations on the light of the fixed ſtars, and this is the general account of it, but there are exceptions. There are evidently, in ſeveral parts of the heavens, fixed ſtars whoſe light is of a very different degree of vivacity, and which twinkle with a great difference of force and ſpirit, although their apparent magnitude be the ſame. We have reaſon to believe that every fixed ſtar is a ſun, and it is by comparing theſe their appearances with the face of the ſun, that we ſhall beſt underſtand the doctrine of their difference in brightneſs. That they are themſelves all fire we are not to doubt, and yet the nature of that fire may be different. We ſee, on the ſun's diſk, parts which burn more intenſely, or are more bright, and others that are leſs. The moſt luminous of theſe equally large ſtars may be all of the ſame nature with theſe bright parts of the ſun's diſk, and the leaſt luminous may be all of the nature, or, at leaſt, the firſt may have a great deal more of the bright part than the latter.

There is one bright ſtar in the heavens which appears greatly brighter, whoſe light has more brilliance and vivacity than that of any other; this is Sirius, or, as we call it, the Dog-Star; the moſt unaccuſtomed eye diſtinguiſhes the difference in favour of this ſtar from all the hoſt of heaven, and will tell you that it twinkles more than all the reſt. This does not riſe at any time to above the height of twenty-five degrees above our horizon. After this we may arrange the ſtars, which are moſt ſtrongly luminous in compariſon of the others, in the following order. The ſecond in brightneſs is, doubtleſs, that in the Goat, the third that in the Harp, Rigel, Arcturus, Antares, or the Scorpion's Heart, come next, all nearly equal, but, if any thing, inferior according to their order; then that in the weſt ſhoulder of Orion; then Aldebaran, or the Bull's Eye, the Little Dog, the Ear of the Virgin, and the Cor Leonis, or Heart of the Lion.

The twinkling of the ſtars has been a puzzling thing with many writers to account for, but it was not in itſelf ſo difficult as they have made it. It is eaſy to conceive that the fixed ſtars, as being in their own nature luminous, muſt caſt out a vaſt number of rays more than the planets, which have no light in themſelves, but only reflect what the ſun throws on them: and, if we add to this conſideration, the motion of the air, we ſhall ſee the effect in the light of one that is very natural, and ought rather to wonder if it were otherwiſe.

We are to conſider, that, beſide the rays which come directly to our eye, there are, at the ſame time, a vaſt quantity of others emitted from a body of fire; theſe are ſcattered about every way, and we do not fail to ſee theſe by the means of extraordinary reflection, or refraction, which the continual agitation of the air cannot but occaſion. All theſe rays, thus ſcattered about, coming together from different ways, form, to our eyes, this

this kind of twinkling, which cannot but be the more confiderable as the ftar is the brighter; for, as to thofe of the fixed ftars, which, on account of their diftance, or from whatever caufe, are lefs bright, the rays, which they fpread abroad in the air, and which fhould re-unite in order to be feen by our eyes, are too fmall a quantity to become vifible. The confequence of this muft be that we fee the body of the ftar without this moving radiation, and, in effect, it is fo in thofe of the fainteft light.

Another thing, which countenances the opinion here advanced as to the twinkling of the fixed ftars, is, that there is much lefs of it feen by the telefcope than by the naked eye. This muft be the confequence on the foregoing principle of employing an inftrument, it re-unites the fcattered rays much more perfectly than our eye can do, and it intercepts alfo a part of the light. Thefe rays, which, from this fenfe of twinkling, may be confiderably diminifhed in the obfervations made with telefcopes, only by covering a confiderable part of the object-glafs with a paper cut through in the middle. The glafs-grinders indeed do, in general, make the arc of thofe glaffes larger than they need, and, in viewing any of the heavenly bodies, it is advantageous to put on a paper with a hole in its middle, in this manner to make it lefs. When this paper has only a fmall aperture in the centre, the object is feen vaftly more determinate, the difk of the ftar appears clear, and the rays are all cut off. This caution is not to be ufed only in viewing the fixed ftars; Mercury and Venus, from their being fo near the fun, have fo brilliant a light, that it is always beft to fee them under this limitation of the area of the object-glafs. All this concurs to prove the doctrine here laid down as to the rays and twinkling of the fixed ftars.

Befide the great reafon for this twinkling of the fixed ftars, deduced from the ftronger nature of their light as intrinfic, and not received, and reflected, there is another. This is the fmallnefs of their apparent diameters; for whatever we may imagine from the blaze which we fee, occafioned by their rays, and which enlarges and extends their apparent furface, we may be affured, that, in reality, they do appear to us extremely fmall. We find, that the largeft of them by the telefcope, allowing all that is required for the moft favourable obfervations, appear but of four or five feconds in diameter, and there are thofe, of the greateft eminence, who will not allow even that, who refer the extent of furface to defects in the obfervation, and affert, that the greateft of them have no diameters at all, as feen by the beft glaffes; but allowing the largeft of them, even the full five feconds in meafure, as feen by powerful telefcopes, what are they when viewed by the naked eye? take away their rays, and they can be only lucid points, or fpecks.

Now we are to obferve, that our atmofphere, particularly that part of it which is near the earth, is full of multitudes of little particles; atoms of folid matter that float about in it; we fee this if we let in a ray of light through the hole of a fhutter into a room clofed elfewhere, the air which feemed vacant is difcovered to be fo full of particles of matter, that we wonder how we breathe in it. When we view one of the fixed ftars we fee it through an air that is full of thefe floating particles, and we may be affured, that many of them are large enough on coming immediately between the eye, and fuch a point of light as a fixed ftar truly is to the eye, to hide that point of light, or take the ftar wholly out of our view by intercepting its rays. Thefe atoms are continually in motion, fo that a

ſtar is no ſooner hid by one of them, but it appears again from its having moved away from before; but then another comes in its place, and again intercepts the view. This is doubtleſs the caſe with regard to the fixed ſtars as ſeen by us with the unaſſiſted eye, they are momentarily obſcured, and left viſible, and this in a ſwift ſucceſſion at all times. We ſee them at one inſtant, and not ſee them the next, and at the ſucceeding one we ſee them again, and this being performed too quick to become the immediate object of our obſervation in the ſeveral changes, is what aſſiſts greatly in making them ſeem to twinkle.

We have a proof that there is a great deal of the effect owing to this from the following obſervation. If we view the ſame ſtar when near the horizon, and again view it when higher in the heavens, it will be found, although it twinkle in both ſituations, yet to do that greatly more when neareſt the earth; or if we look at two fixed ſtars, of equal magnitude, ſuppoſe the ſecond, the one near the zenith, the other near the horizon, although they are, in all reſpects, with regard to us, otherwiſe perfectly like to one another, that which is ſeen near the horizon will twinkle greatly, that near the zenith much leſs. The reaſon is plain, although both twinkle by the mere brightneſs of their light as being fiery bodies, and having the ſource of it in themſelves, yet a part of the appearance being alſo owing to their orbs being occaſionally intercepted by particles floating in our air, that part muſt differ greatly in theſe two obſervations; for as it is only about the earth that the air is thus loaded with theſe particles, we ſee the ſtar through a much larger quantity of this air, thus filled with atoms, when they are near the horizon, than when we view them at or near the zenith.

Beſide, although this twinkling of the fixed ſtars be one of their great characteriſtics, and the planets are diſtinguiſhed from them by ſhining with a ſteady light; yet as the difference between innate and reflected brightneſs is not all in this conſideration, neither is the characteriſtic abſolute; ſo far as the twinkling of the fixed ſtars depends upon their fire, they are diſtinguiſhed by it from the planets, but when this other cauſe aſſiſts, thoſe orbs ſhare it. We ſee no twinkling in thoſe planets which often appear higher in the heavens, and which we view uſually in ſuch a ſituation; but it has been ſaid by many, that Mercury and Venus have ſome twinkling; it may be, in ſome ſmall degree, perhaps, referred to their having more brightneſs, as being, at the ſame time, nearer to the ſun, and nearer to us; but it is principally owing to this, that Venus is uſually, and Mercury is always, ſeen near the horizon; ſo that viewing them through a vaſt quantity of this thick and turbid air, although the *floating particles* are not ſingly large enough to cover, or obſcure their orbs, little cluſters of thoſe particles occaſionally get together, and, in ſome degree, mimic, although they do not abſolutely produce the effect.

TYCHONIAN SYSTEM. After Copernicus had baniſhed the Ptolemaic ſyſtem out of the world, by a revival and improvement of the old one of Ariſtarchus and Philolaus; and, inſtead of the earth, had placed the ſun, as fixed and immoveable in the centre of the univerſe, Tycho Brahe, a great aſtronomer, and one to whom the world is, in many reſpects, greatly obliged, found his objections to ſome part of it, and adopting ſome, and rejecting the reſt of it, he publiſhed a ſyſtem which was part Copernican, and part Ptolemaic, with his additions and improve-

improvements, and it has been called by his name.

The ſmall parallax of the fixed ſtars, as ſeen from the earth in the different parts of her orbit, renders it a neceſſary ſuppoſition, that the diſtance of thoſe ſtars from the ſun, or from our ſyſtem, is immenſely great. It is, indeed, neceſſary, in order to underſtand and account for this phœnomenon, according to the Copernican ſyſtem, that their diſtance, in proportion to that of the earth from the ſun, which is in itſelf very great, ſhould be thus immenſe. Tycho did not chuſe to ſuppoſe this probable, and, upon his doubt on that head, he formed another ſyſtem. In this he agrees with Copernicus about Jupiter and Saturn, and Venus and Mercury, turning about the ſun, but he gives the ſun an annual motion round about the earth, according to the principles of Ptolemy.

According to this hypotheſis, then, the ſun and the moon turn round about the earth, and, at the ſame time, the five other planets perform their revolutions round about the ſun. This ſyſtem, therefore, places the earth as fixed and immoveable in the centre of the univerſe, and the ſun, even while it is in motion itſelf, is a centre for the reſt. According to this ſyſtem, two of the planets, Mercury and Venus, would paſs, during a part of their revolutions, between the ſun and the earth, and would give different faces, or appearances, in the manner of the moon. It is found by the aſſiſtance of teleſcopes, that theſe planets do, in reality, give us ſuch appearances, and that Venus is often very diſtinctly ſeen in form of a creſcent; this would have tended greatly to have ſupported Tycho's ſyſtem, were there no other way to account for it; but all that is neceſſary to this, is to ſuppoſe them between the earth and the ſun; and Copernicus fixed their places there.

According to this ſyſtem, the circles of the three other, or ſuperior planets, take in the earth, which is ſituated between that of Venus, and that of Mars. It is eaſy to ſee therefore, that this ſyſtem will repreſent in its way all the appearances, becauſe the apparent motion of each planet will be compoſed of its proper motion about the ſun, and of their general movement, by which they are carried along with the ſun round about the earth.

We are not to wonder, that this ſyſtem has had its followers; the notion of the earth being a fixed point, and the centre of the univerſe, is natural, and will lead many.

V.

VARDI. A name by which ſome, who are fond of uncommon terms, have called the conſtellation Eridanus; it is a Mooriſh word, and ſignifies only a river.

VENUS. The brighteſt and largeſt to appearance of all the planets; diſtinguiſhed in the heavens by a ſuperiority of luſtre from all the others, and incapable of being miſtaken for any of them. The diſtinction between fixed ſtars and planets to the eye, is, that the latter have, although a very bright, yet a more placid luſtre than the former. The fixed ſtars are ſuns, they have the ſource of light in themſelves: the planets are globes of earth, or opake matter, which only receive light from the ſun, and reflect it back again; notwithſtanding, therefore, that the fixed ſtars are at an immenſely greater diſtance; it is natural that their brightneſs ſhould be greater than that of the planets. It is this that gives them that twinkling which diſtinguiſhes them from the planets when we look at them, but this is not ſo abſolute a diſtinction as has been ſuppoſed; for the planets, which are neareſt to the ſun, do receive their light in ſo great a degree, that being alſo near to the earth, they reflect it with a brightneſs which does not belong to the others. Venus, in this manner, twinkles a little, and Mercury, although ſo ſmall, much more. In theſe, however, the effect is ſo much leſs than in the fixed ſtars, that it would not confound them with thoſe luminaries. In Saturn, Jupiter, and Mars it is not ſeen at all; ſo that thoſe three planets are entirely, and theſe two are ſufficiently diſtinguiſhed from the fixed ſtars by their light, or by the radiance of their light alone.

Venus does not need this occaſion of diſtinction, for her apparent magnitude, and fine, clear, and lively colour, is ſufficient; there needs no other means of diſtinction to a ſtar that is the largeſt in the heavens, but if there did, this peculiarity of light would give it. Saturn is pale and dead, and Mars is ruddy, and troubled in his light, except juſt in his oppoſitions; Jupiter is white and bright, but Venus is ſtill whiter, purer, and brighter.

One would not imagine, that this planet, which appears ſo much ſuperior to Jupiter and Saturn in the heavens, is ſo inconſiderable, in compariſon of them, as it truly is: and, on the other hand, one would not imagine, that what appears only a lucid ſpangle in the heavens, was ſo vaſt a globe as this planet truly is; it is the diſtance that does all this, that gives, and that takes away, the apparent magnitude of things, in compariſon with the more remote, and with the nearer. Venus, as ſuperior as ſhe ſeems to Saturn, is but a little more than a tenth part of his bigneſs in diameter, and as ſuperior as ſhe ſeems

is

is not a tenth part of his diameter, and the difference of the proportion these planets bear to her, is not so much from their difference in real magnitude, for that is not proportionably great enough to occasion it, but to their different distance, Saturn being vastly the more remote; but though Venus be so inconsiderable in proportion to these two vast globes, she is very nearly equal to our earth in size. The diameter of Saturn is sixty-seven thousand miles, that of Jupiter is seventy-seven thousand, the diameter of the eatth is seven thousand, nine hundred, and thirty-five, and that of this planet Venus is seven thousand, nine hundred. The distances of these several planets from the sun is also very different; Saturn is seven hundred and eighty thousand millions of miles distant from that luminary, Jupiter is four hundred and twenty-six thousand millions of miles from it, the earth is eighty-two milllions, and Venus only fifty-nine; what a difference between the place of this planet in the universe and that of Saturn! her brightness, as seen from the earth, is not a wonder.

Those, who divide the planets into superior and inferior, calling the three, which are more distant from the sun than the earth is, the superior planets, make Venus, who is immediately under the earth, the upper of the two inferior planets; the other is Mercury, whose course is so near the sun that he is seldom to be seen long together. The revolution of a planet round the sun is the measure of the year of that planet; and it is very different in the several planets in proportion to their distances. The revolution of Saturn is 10759 days, that of Jupiter 4332 days; these are, therefore, the measure of the several years. The earth's we know to be three hundred and sixty-five days, and that of Venus is only two hundred and twenty-four days, so that her year is of no more extent than that compass; but, with respect to the earth, Venus seems, instead of much shorter, to have a much longer year than ours; for, although this is the period of her true revolution, yet, with regard to the earth's, appears to be about nineteen months in making that revolution. In this time she passes twice in conjunction with the sun; one of these times between the sun and the earth, which is called her inferior conjunction; and the other beyond the sun, which is then between her and the earth, and this is called her superior conjunction. In the whole revolution which Venus makes round the sun, she never appears to be more distant from him than forty-seven degrees and an half; nearly as the moon on the fourth day after her conjunction. The distance of that planet, at that period, is equal to the greatest distance of Venus from the sun, and sometimes she returns again toward him when he has not got quite to the distance of forty-five degrees and an half; thus her greatest digressions vary about two degrees.

When Venus follows the sun's rays on the eastern side, and appears above the horizon after sun-set, if we direct a telescope to her, we see her appear nearly round, and but small, for she is, at this time, beyond the sun, and presents to us her enlightened hemisphere. According as she departs from the sun towards the east, she augments in her apparent bigness, and, on viewing her through the telescope, alters her figure; she abates of her roundness, and appears, at different times, like the moon in the different stages of her decrease. At length, when she is at her greater digressions, she appears no longer round as at first, but exactly as the moon in her first quarter; she is now an half moon, she shews the earth only one half of her enlightened hemisphere, and exhibits exactly the same ap-

pearance

pearance with the moon, when from a full ſhe has decreaſed to a half moon.

After this, as ſhe approaches, in appearance, to the ſun, ſhe appears concave in her illuminated part, as the moon when ſhe forms a creſcent. Thus ſhe continues till ſhe is hid entirely in the ſun's rays, and preſents to us her whole dark hemiſphere, as the moon does in her conjunction, no part of the planet being then viſible.

After this, when ſhe departs out of the ſun's rays on the weſtern ſide, we ſee her in the morning juſt before day-break. It is in this ſituation that Venus is called the morning ſtar, as in the other ſhe is called the evening ſtar. If we direct a teleſcope to her at this time, ſhe makes a moſt beautiful figure. Venus is, in this ſituation, a fine and thin creſcent, juſt a verge of ſilver light is ſeen on her edge. From this period ſhe grows more and more enlightened every day, till ſhe is arrived at her greateſt digreſſion, when ſhe appears again a a half moon, as the moon in her firſt quarter. From this time, however, if continued to be viewed with the teleſcope it is found to be more and more enlightened, but ſhe is all the while decreaſing in magnitude; and thus continues growing ſmaller and rounder till ſhe is again hid, or loſt, in the ſun's rays.

Venus is ſo conſiderable a ſtar, that ſhe is ſometimes viſible in broad day-light; and often in the night, if the place be quite dark, her light is ſo conſiderable, that ſhe caſts a very fair ſhadow behind objects. Aſtronomers, by the aſſiſtance of teleſcopes, frequently purſue her to the time of her conjunctions with the ſun, in which ſhe is viſible to theſe inſtruments when ſhe has but a very little latitude. The view of her when in a creſcent, and at her brighteſt times, is the moſt pleaſing obſervation of all that the heavenly bodies afford us by that inſtrument; ſhe has all the appearance of the moon at that period, and we diſcover ſpots on her ſurface altogether like thoſe which are ſeen in the moon, and full as large in proportion. Venus, in her revolutions, comes ſometimes ſo near the earth, as to be within one quarter of the diſtance of the earth from the ſun; this is a favourable conjuncture for the determining her parallax. In the inferior conjunctions of Venus with the ſun, the planet almoſt always paſſes ſomewhat above, or ſomewhat below, that luminary, not immediately over his diſk, becauſe of her apparent latitude, which, according to the reſpect it has to the diſtances of Venus from the earth, and from the ſun, is then three times, or thereabouts, greater than her latitude ſeen from the ſun.

In 1693 ſhe was ſeen in England paſſing over the diſk of the ſun; ſhe appeared in ſhape round, very obſcure and dark, and her diameter equal to about a twenty-ſixth part of that of the ſun; and, as the diſtance of Venus from the earth was to that of the ſun from the earth as twenty-ſix to an hundred, we may infer, that the diameter of Venus, at that diſtance from the ſun, would have appeared equal to about one hundredth part of the ſun's diameter, conſequently the diameter of Venus muſt be about equal to that of the earth. It is found to be ſo by other obſervations; and thus it is that one truth corroborates another. From that time to this it has not happened that Venus has paſſed immediately before the ſun, but there will be, not very many years hence, an opportunity of ſeeing the phœnomenon; it will happen in the year 1761.

The occaſion that this happens ſo ſeldom, is, that, when Venus, in her inferior conjunctions with the ſun, is at the diſtance of one degree and forty-eight minutes of her nodes, her latitude, viewed from the ſun, is ſix minutes and twenty-five ſeconds to the ſouth,

fouth, or to the north, fo that fhe muft appear to us at leaft fixteen minutes and thirty feconds diftant from the centre of the fun, which, exceeding the diameter of the fun's difk, it follows from this, that, when Venus is at a diftance from her nodes that exceeds one degree and forty-eight minutes, fhe muft, in her conjunction with the fun, pafs either above, or under his difk, and not appear upon it.

Some of the writers of aftronomy have fuppofed this planet to be meant by the term Mazzaroth in the Old Teftament; and the authors of the Latin tranflation of the bible have put Luciferum in thofe places where this word, in the original, occurs. The authors of the Greek tranflation have continued the word which they found in the original; and indeed it were to be much wifhed that they had, in all inftances, where words were ufed relating to fciences which they did not underftand, done the fame. There are but about four conftellations mentioned in the Old Teftament, and we find them giving wrong interpretations of every one of thefe; Chimah, which fignifies Orion, they rendered the Pleiades; Cheiil, which fignifies the Bear, they render Orion; and Aifh, which is the name of the Pleiades, they render Arcturus; they make nonfenfe of all the paffages in which thefe are named by this falfe verfion, but, of the laft in particular, they make even an abfurdity. The Pleiades was the conftellation, which, according to the old accounts of time, opened the year, and confequently the other ftars, as its followers, in the courfe of that time, might very naturally be called its fons; but what meaning could there be in fpeaking of the fons of Arcturus? certainly none.

It had been much better, therefore, that the tranflators, in all places where they met with a word which they had not opportunities of underftanding, had continued it in its place in the verfion, and left the curious to examine what fhould be its meaning, than that they had given a word meaning fomething elfe, and by that at once mifinformed mankind, and prevented enquiry. Venus is a very confpicuous planet, and it feems to have been for that reafon only (for it would be very hard to find another) that its name was given in the place of Mazzaroth. The word is plural, and plainly means not one ftar, but many; and, indeed, by all that is faid of it, feems to have reference to a part of aftronomy fo very old, and of the fucceeding ages fo very much neglected, that it is not a wonder any thing fhould be fooner gueffed at; but it may be proper to enquire into it.

We find, in the accounts of the Chaldæan aftronomy, frequent reference to what is called the circle of the moon; and it is evident, that, by this, is meant a circle correfponding to the moon's motions, and containing in it, as the zodiac does, the figns through which the fun paffes, thofe ftars, or congeries of ftars, which the moon comes in the way of every night in her periodical revolution round the earth. As that month confifted of twenty-eight days, thefe congeries of ftars muft be twenty-eight in number, and thefe are what we find, in the Arabic aftronomy, called the manfions of the moon. This circle contained thefe manfions, and was known by the name of Mazzaroth, or Mazzaloth, a plural ufed to exprefs it, as being compofed of a number of diftinct things, twenty-eight manfions, and, by the fentence in the book of Job, which fpeaks of bringing forth Mazzaroth in its feafon, is meant, not the rifing of the planet Lucifer, or Venus, but the continuing the courfe of this circle, and occafioning every part of it, or every manfion, to return in its proper period of

of time. *For an account of the ſpots of* VENUS, *ſee the article* SPOTS.

VERTICAL CIRCLES *of the Sphere.* All circles, which paſs from the zenith and the nadir, and divide the horizon into two parts, are called vertical circles of the ſphere: that which paſſes through the eaſt and weſt point, is called, by aſtronomers, the firſt vertical. This cuts at right angles the circle which paſſes through the north and ſouth points, and which, in that paſſage, blends itſelf with the meridian from the place whence it is obſerved. It is on theſe circles that we meaſure the heights of ſtars above the horizon.

We meet with the term vertical applied to the ſituation of the ſun, with reſpect to certain parts of the earth, both in the writings of the aſtronomers and the geographers. No perſons can have the ſun vertical (for the term is underſtood exactly as already explained) unleſs the ſun's diurnal motion is performed in a circle which paſſes through the zenith of that place. In this caſe the ſun will, on that day, in which the circle, he deſcribes in his revolution, ſo cuts the zenith, be perpendicularly over the heads of the people at noon, or will be in the zenith, and in conſequence of this they will have no ſhadows that day at noon, and the ſun will ſhine down their chimnies. This is the ſun's being vertical in the moſt exact ſenſe of the word, and there are people in this ſituation; but it is a liberty of ſpeech to apply the term to people in places where the ſun, at noon, is, at certain times, nearly vertical; this creates confuſion.

It is palpable the ſun can, when in the equator, be in this ſituation, with reſpect to that part of the earth only where there is not any obliquity; and this is the caſe to thoſe who live under the line at the two days of the equinoxes. To theſe people, the ſun, on the tenth of March and on the twelfth of September, is, at noon, truly and preciſely in the zenith, and he is truly vertical, and they have no ſhadows, for the ſun's courſe, on thoſe days, being in the celeſtial equator, he muſt paſs through their zenith.

As the ſun is continually changing place in the heavens, it is only on theſe two days in the year that he is vertical with reſpect to theſe people; as, from either of theſe days, his motion is performed in a parallel at ſome diſtance from the celeſtial equator, it is vertical, not to thoſe under the equator, but to thoſe who live in a parallel on the earth correſponding to that parallel which the ſun deſcribes in the heavens, and ſo on every day as he advances toward either tropic.

Thus it appears, that the ſun is, at certain ſeaſons, vertical, or directly over the heads of all who inhabit any part of the torrid zone; and it will alſo be found, that it cannot be vertical with reſpect to any *other people* at any time whatſoever. When the ſun, by his motion, deſcribes a circle that is in four degrees of north declination, he is, at noon, vertical to thoſe perſons, who, on the earth, live four degrees of north latitude; when the ſun is in five degrees north declination, he is at noon vertical to thoſe who live in five degrees of north latitude, and ſo of the reſt as far as the tropics, and when he is in either tropic in the heavens, he is vertical, at noon, to thoſe who live on the earth in the correſponding tropics. After this, the ſun meaſures back his declination, ſo that, advancing no farther north, he can never be vertical to thoſe who live any farther north; therefore the torrid zone is the only part of the globe in which he is, at any time, vertical. To uſe the moſt expreſs terms, the tropics are parallels at twenty-three degrees and thirty minutes from the equator,

equator, and as the ſun never performs his revolution in a parallel more remote than theſe from the equator, it is plain, that it can never be vertical to any who live at a greater diſtance than that of twenty-three degrees and an half from the terreſtrial equator. To thoſe, who live within the torrid zone, or between the terreſtrial tropics, the ſun is vertical twice every year, and this exactly in correſpondence to their parallels.

UGLACK. A name by which ſome have called the conſtellation Capricorn; it is the Turkiſh name to that conſtellation, and, in that language, ſignifies a young goat, or kid.

VIA IGNEA, *the Fiery Way*. This is one of the many names that have been given to the Milky Way, or Galaxy. This is capable of a double explication, and, to know which is the proper one, we ought to be informed of the ſentiments and the learning of thoſe who give it. It may refer to the Egyptian fable of the appearance being made to commemorate the flight of their goddeſs Iſis from Typhon, in which ſhe ſcattered burning ſtraw behind her all the way. Many have hence called it the Strawy Way, and they may as well call it the Fiery Way. But it may alſo refer to the Greek philoſophy, which ſuppoſed this expanſe of brightneſs to be really a part of the celeſtial fire. The old ſtoics believed a region of fire above all that is viſible to us in the heavens, and they ſuppoſed this luminous expanſe to be owing to a crack in the roof of heaven (to uſe the expreſſion) through which this celeſtial flame diſcloſes itſelf. This is a ſenſe in which it was very natural to call the Milky Way a Fiery Way; and this was the more likely to be received, as it favoured the old philoſophy of that ſect, according to which the world was to be deſtroyed by fire, and, as it was generally ſuppoſed, this was to be done by fire, making its way out of the upper heavens, this crack, at which it already diſcloſed itſelf, ſeemed to verify the threat, and nothing more was underſtood as neceſſary to complete the cataſtrophe, but the widening of this crack by ſome natural accident, or by the immediate will of the gods at the appointed and determined time.

VIA LACTEA, *the Milky Way*. A broad lucid tract in the heavens. The appearance in this part of the heavens is owing to a multitude of ſmall ſtars, which here ſtand very cloſe to one another, and although they are too minute to be diſtinguiſhed by the naked eye, yet, blending their light together, form that whiteneſs which is ſeen covering ſo large a tract in the hemiſphere. About the ſouth pole there are detached ſpecks of white of this kind, ſome large, and others ſmall; they are of the nature of this Milky Way; they have been ſuppoſed to be ſpaces in the heavens luminous of themſelves, and to have no ſolid body, nor any natural ſource of light in them. But teleſcopes having ſhewn us what is the true ſtate of the caſe in the Milky Way, we have no reaſon to queſtion but it is exactly the ſame there. The appearances in the heavens, called nebulous ſtars, are alſo ſmaller ſpecks of this kind; they are not ſingle ſtars, but cluſters of minute ones.

The Milky Way may, in ſome degree, be reckoned a conſtellation; for if we underſtand by that term a certain number of ſtars, diſpoſed in a certain form as ſeen from the earth, this is truly the caſe with this portion of the heavens; and although the light of the ſeveral ſtars does not travel down to us diſtinctly, it does in the blended mixture, in which the whole is ſeen of this milky, or white hue, although one particular ſtar is

 viſible.

visible. Thus we may call the Via Lactea a constellation of telescopic stars; a sea of great breadth, of a whitish colour, and encompassing the whole heavens; it goes sometimes in a double path, but usually in a single body; it passes through many of the constellations in its way, and keeps its exact place with respect to them; it runs through Cassiopeia, Perseus, and Auriga, by the feet of Gemini, and the club of Orion; it pursues its course through the breast of the Unicorn, the tail of the Great Dog, the Ship, the Royal Oak, the Cross, and along the feet of the Centaur; hence it continues its way till it comes over against the Altar, it breaks like a river that had met a ridge, or extent of land in its way, and divides into two streams; its eastern part then passes through the Altar, the extremity of the Scorpion's tail, and the east foot of Serpentary; hence it is continued through Sagittary's bow, Sobieski's shield, and by the feet of Antinous, and the Swan, where the largest part of it again joins the other, having, as it were, surrounded the island that broke its course. The western stream, on the other hand, passes through the anterior part of the Scorpion's tail, the right of Serpentary and the Swan, and finally ends its course in Cassiopeia. This is the course of that singular and beautiful appearance through the heavens, and in all this it is distinct and beautiful.

The Greeks were determined to have the observations of the heavens seem to have been begun in their country. We know, that they indeed received the rudiments of the science from Egypt; but it was the labour of their lives to drown that article. With this intent they converted part of their own history, with every portion of the heavens, and whatsoever had a name among the stars, was pretended to derive it from something relating to their country; it was a judicious piece of artifice; for to whatever country we find the stories of the origin of things, to that we shall be very apt to refer the whole. Thus they told us, that Saturn, which they called Helius Solis, was their Phaeton, whom, when Jupiter had struck dead for misguiding the chariot of the sun, his father Phœbus changed him into a planet, and placed the most distant from the sun of all the others, to prevent farther mischief. Jupiter, which they called also Phaethon, they said, was once a mortal of that name. One of the men, formed by Prometheus, who being too perfect for the earth, they took into the skies, and made this planet. Mars was their Hercules, taken from the Pyre, and preserving the manner of his death in that fiery look which distinguishes it from all the other planets. Venus, which they called also Hesperus, a son of Cephalus and Aurora, transformed into this planet; and Mercury, Stilbon, the inventor of the division of the year into months and weeks, raised to the skies, and made that planet, still keeping near the sun, whose motions he used to attend so closely.

In the same manner the constellations they informed the world were founded on their history; and who would then doubt that they were formed among themselves? Thus, the Dragon was that which had been used to guard the Hesperian fruit, Capricorn was their Ægipan. The mixed figure into which Pan transformed himself for fear of Typhon, plunging his hinder parts into the river; the Bear was their Calistho, changed first on earth into that animal, and then taken up into the skies, and so of all the rest.

In this manner the Milk Way, or Via Lactea, an extent in the heavens, equal to many of the constellations put together, and too conspicuous not to be taken notice of, they

they alſo referred to their own hiſtory. They tell us, that Juno, not regarding what it was ſhe did, gave ſuck to Mercury when an infant, but that as ſoon as ſhe caſt her eyes that way, ſhe threw him from her, and as the nipple was drawn from his mouth, the milk ran about for a moment. Homer tells us, his Juno had the eyes of a cow, one would think by this ſhe had the teats of a cow too, and of a monſtrous one into the bargain; it is a fine mark of ſuch an incident, but their ſtories are all of this wild kind. They do not, however, quite agree about this, ſome of them ſay it was not Mercury, but Hercules that was the infant. They tell us, that he was laid by the ſide of Juno when he was aſleep, and that on waking ſhe gave him the nipple; but ſeeing quickly what it was, ſhe threw him from her, and the ſame accident happened, and the heavens were marked by the waſted milk.

Many of the commentators on the book of Job have ſuppoſed, that the Milky Way is the part of the heavens referred to in that paſſage, where the author, ſpeaking of the Almighty, ſays, that "his ſpirit beautified "the ſkies, and his hands had formed the "Crooked Serpent." It is very palpable from the connection, that the animal, called the Serpent upon the earth, could not be meant by the paſſage; and as ſomething in the heavens muſt be intended by the term of ornamenting and beautifying the ſkies, they were at ſome pains to find what it muſt be there, and ſomething that might be conſidered as an ornament, they have thought of the zodiac, and they have thought of the Milky Way, more indeed have been of this laſt opinion than of the former, and they have ſuppoſed this extended ſpace, which is bent in ſeveral parts of its courſe, was called by the Hebrews the Serpent. It is certain, that the Milky Way is a very conſpicuous part in the ſkies, and large enough to be taken notice of, but it is not at all like a ſerpent. The Egyptians, and the Chaldæans, among whom the Jews had been ſufficiently acquainted, were careful obſervers of the heavens, they would not fail to have traced the courſe of this milky, or lucid path, and they would have found its diviſion, as already mentioned. This might very well ſerve for a part of a ſea, but, by no means, for any part of the figure of a ſerpent; ſo that it is not likely that the Jews, or indeed any other people, had a cuſtom of calling this part of the heavens by that name. A path way, or a ſea, were terms much more natural to be applied to it, and we find it called by ſuch, but there is no authority for ſuppoſing a ſerpent any of the names by which it was underſtood.

Indeed it is much more natural to underſtand the words another way, and, in their plainer ſenſe, "his hand hath formed the "Crooked Serpent in the ſkies;" he that formed the ſkies, formed thoſe ornaments alſo which have place in them, and are called the conſtellations. The author might have named all theſe, but it is very natural to ſelect one, and this ſeems to be what he has done, and the Serpent, or Crooked Serpent, is naturally to be underſtood of the conſtellation of that name: there is the more reaſon to be of this opinion, becauſe the ſame author names in the ſame book other conſtellations. "Canſt thou bind the ſweet influence "of the Pleiades, or looſe the bands of "Orion?" ſo at leaſt they are tranſlated. Now that he who had named one conſtellation, ſhould name another, is not very ſtrange; nor is it a forced conſtruction, that when he who had ſpoken of the Pleiades and Orion, meant thoſe, or ſome other conſtellation.

When he mentions the Crooked Serpent, ſhould mean the Serpent, not that of Ophiucus, becauſe then the human figure would alſo have been named; but the Dragon, as we call it, is a conſtellation near the north pole.

While the Greek fabuliſts gave for the origin of this lucid trace in the heavens, the ſpilling of the milk of Juno, and the Egyptians called it the Way of Straw, from the ſtory of its owing its origin to burning ſtraw, thrown behind the goddeſs Iſis in her flight from the giant Typhon, the philoſophers gave it a different name, and different origin. We find them eſteeming it to be a tract of liquid fire, ſpread in this manner along the ſkies; and others of them ſuppoſing a celeſtial region beyond all that was viſible, and imagining, that fire, at ſometime let looſe from thence, was to conſume the world, made this a part of that celeſtial fire, and appealed to it as a preſage of what would ſurely happen; they underſtood the tract a long while. This diffuſed brightneſs is ſeen to be a crack in the wall of heaven, if it might be ſo called, and thought this was a glimmering of the celeſtial fire through it, and that there required nothing more than the undoing of this crack by ſome accident in nature, or by the will of the gods, to make the whole frame ſtart, and let out the fire of deſtruction.

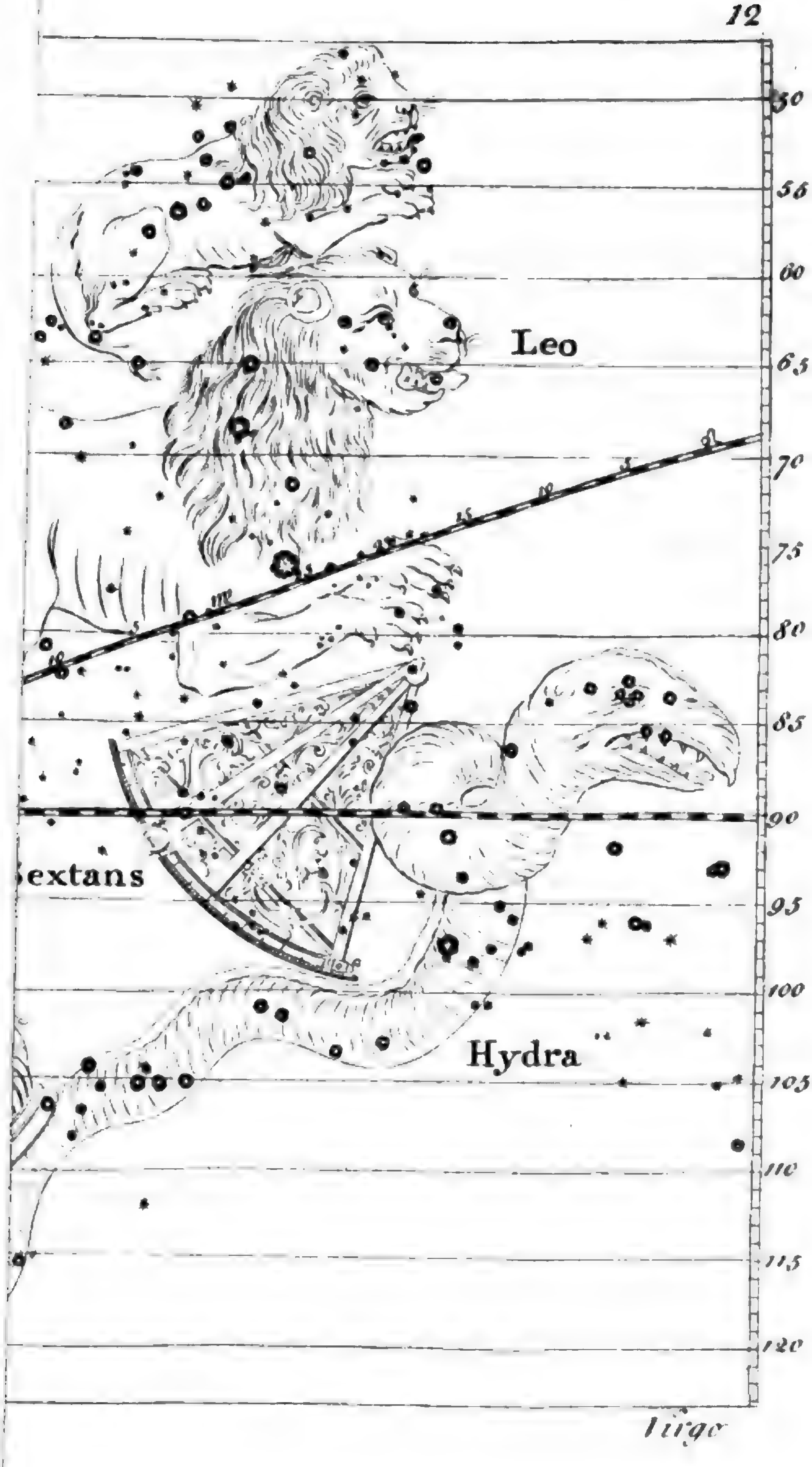
VIRGIN MARY. A name given by Schiller, and the enthuſiaſts, his followers, to the moon. This writer, after he had new modelled, and new named all the conſtellations, raiſing the twelve apoſtles into the zodiac, and the patriarchs Abraham, Iſaac, and Jacob, with the reſt of the ſcripture-people, into one, or other part, of one, or other hemiſphere, began with the planets, the ſun and the moon. Saturn he new named Adam, Jupiter, Moſes, and Mars, Joſhua; Venus was St. John the Baptiſt, and Mercury, Elias; the ſun he called Chriſt, the ſun of righteouſneſs, and the moon, the Virgin Mary.

VIRGO. One of the conſtellations of the northern hemiſphere, and one of the twelve ſigns of the zodiac; it is one of the old forty-eight conſtellations, and is mentioned by the aſtronomers of all ages and nations, whoſe works have come down to us. It is a very large conſtellation, and takes in a conſiderable quantity of ſtars, ſeveral of them of conſiderable ſize.

The Virgin has been a little altered from her original appearance; ſhe maintains the ſame place which ſhe always did occupy in the heavens; but the Greeks, diſpleaſed with the naked figure, or nearly naked, of the Egyptians, for ſo the Virgin appears on their old monuments, as they intended to make her of better condition, no matter for propriety, cloathed her better.

The Virgin is, at this time, *repreſented* in all the ſchemes of the heavens, as a woman with wings, or, if it muſt be called by the name, it would moſt naturally claim from the vulgar, an angel; ſhe is in a poſture, as it were, of walking, her legs at ſome diſtance, and her wings falling ſtrait down her ſides; ſhe has no ornament on her head, beſide her hair; but the painters, out of decency, have thrown a looſe robe over almoſt her whole figure, ſhe holds an ear of corn in her left hand, and in her right a branch of palm.

The conſtellations, between and among which this of Virgo is ſituated, are Bootes, Leo, Crater, Corvus, Hydra, and Libra. The left foot of Bootes comes very near to the right hand of Virgo; the tail of the Lion approaches to the top of her right wing, and his hinder parts are at a ſmall diſtance from her head;


12
50
55
60
Leo
65
70
75
80
85
90
Sextans
95
100
Hydra
105
110
115
120
Virgo

head; the Cup and the Crow run parallel almoſt with her left wing; the Hydra comes toward her left leg, and the Balance is juſt oppoſite to her feet, and is as near to them as the Lion is to her head. Some of the other ſigns of the zodiac are figured at more diſtance from their neighbours, but it is becauſe they are ſmaller; this is ſo large that it occupies very nearly the whole ſpace aſſigned between Leo and Libra.

Virgo, according to the old aſtronomers, compriſed, in her extent, thirty-two ſtars. Ptolemy ſets down that number, and we know he was a ſtrict follower of Hipparchus; he ſays, indeed, that he a little altered the figure of the Virgin, putting thoſe ſtars in her ſide which his predeceſſor had accounted to her ſhoulder, but he made no alteration in their number. Tycho Brahe counted thirty-three ſtars in Virgo, Hevelius fifty, and Flamſtead an hundred and ten. Of theſe there is one of the firſt magnitude, large and beautiful, in the left hand, which holds the ear of corn; there is not one of the ſecond, but there are three or four of the third magnitude, one in the bending of the left wing, another, the ſecond in order, in the ſame wing, another, preceding it, in the ſame wing, diſputed by ſome as to its magnitude, and degraded to a fourth; there is another, however, an allowed third, in the right ſide near the girdle; and another in the girdle, in the tip, or near it. Beſide this, there are ſeveral very conſpicuous ſtars, they are principally of the fourth magnitude, and are ſo happily ſituated, that there is not, in all the heavens, a conſtellation more eaſy to be diſtinguiſhed at ſight; the wings are both very fully ſpangled with ſtars, eſpecially the right wing. There are ſome upon the face and neck, and a great many on the lower part of the robe; the palm-branch in her right hand has ſeveral near it, and in a right line with it, but they are unformed ones; thoſe within the out-line are but few. The leg that is naked (for the left is covered by the robe) has only ſome ſmall ſtars on it, but there is a bright one on the foot.

The Greeks, determined to find ſome ſtory in their hiſtory or fables that ſhould ſuit with the origin of every conſtellation, have not been wanting with reſpect to this; they tell us, that the Virgin, now exalted into the ſkies, was, while on earth, that Juſtitia, daughter of Aſtræus and Ancora, who lived in the golden age, and taught mankind their duty, but who, when their crimes encreaſed, was obliged to leave the earth, and take her place in the heavens; but about this they are not all agreed. Heſiod gives the celeſtial maid another origin, he ſays ſhe was the daughter of Jupiter and Themis; and there are others who depart from both theſe accounts, and make her to have been Erigone, the daughter of Icarius; others, Parthene, the daughter of Apollo, whom he, at her death, placed there; and others, from the ear of corn, have called it a repreſentation of Ceres; and others, from the obſcurity of her head, of Fortune.

It is not among theſe people that we are to look for a real hiſtory of the origin of the conſtellations; they received them from the Egyptians, and, content with the figures, never enquired into the meaning of them. The Virgo of the Egyptians, as has been already obſerved, was not this well-winged, and well-dreſſed creature, but a naked, or almoſt naked wench, with an ear of wheat in her hand. The conſtellation marked the place at which the ſun arrived in the heavens when the corn began to grow brown, and promiſe harveſt. The figure was a peaſant belonging to the harveſt-work, and the ear of corn denoted her employment. It will be found, however, even on

on this enquiry, that there had been, at some time, a people, who were to the Egyptians, what the Egyptians were to the Greeks, and that they, from these people, as the others afterwards from them, received the figures of the constellations, which they retained without any regard to their meaning. The constellation Virgo, which marks the space in the heavens at which the sun arrives in August and December, may, indeed, very well denote the harvest's approach with us, and it might do so to the people who invented the figure of the harvest-woman to stand there, but it could not with the people of Egypt. August and September are the months preceding harvest in the temperate zone, but it is otherwise with respect to Egypt, for there the corn is only three months in the ground. It is sown in the mud, left by the overflowing of the Nile in December, and grows so quick, that the time of gathering it is in March or April; so that the sign Virgo was, undoubtedly, invented, and placed in this part of the zodiac, not by the Egyptians, (at least not by that people when settled in Egypt) but, probably, by their ancestors, when they lived together after the flood, and had not yet divided into different states and kingdoms.

The antients, as they gave each of the twelve months of the year to the care of some one of the twelve principal deities, so they also threw into the protection of each of these one of the twelve signs of the zodiac. Virgo, from the ear of corn in her hand, naturally fell to the lot of Ceres, and we accordingly find it called Signum Cereris.

VISION. When an object is so disposed, that the rays of light, coming from all parts of it, enter the pupil of the eye, and present its image on the retina, that object is then seen. This is proved by experiment, for, if the eye of any animal be taken out, and the skin and fat be carefully stripped off from the back part of it, till only the thin membrane, which is called the retina, remains to terminate it behind, and any object be placed before the front of the eye, the picture of that object will be seen figured as with a pencil on that membrane. There are thousands of experiments which prove that this is the mechanical effect of vision, or seeing, but none of them all appear so conveniently as this which is made with the absolute eye of an animal; an eye of an ox newly killed shews this happily, and with very little trouble. It will, indeed, appear singular in this, that the object is inverted, in the picture thus drawn of it, in the eye, and the case is the same in the eye of a living person. It is unquestionable, that the pictures of all objects are represented to us inverted, but the soul sets that right; it must be thus, seeing that there is no material apparatus for the performing the change, or *setting* it upright.

The misrepresentations of vision frequently depend upon the distance of the object. Thus, if an opake globe be placed at a moderate distance from the eye, the picture of it upon the retina will be a circle properly diversified with light and shade, so that it will excite in the mind the sensation of a sphere or globe; but, if the globe be placed at a great distance from the eye, the difference between those lights and shades, which form the picture of a globe, will be imperceptible, and the globe will appear no otherwise than as a circular plane. In a luminous globe, distance is not necessary in order to take off the representation of prominent and flat; an iron bullet, heated very red hot, and held but at a few yards distance from the eye, appears a plane, not a promi-

nent body; it has not the look of a globe, but of a circular plane. It is owing to this misrepresentation of vision that we see the sun and moon flat by the naked eye, and the planets also, through telescopes, flat. It is in this light that astronomers, when they speak of the sun, moon, and planets, as they appear to our view, call them the disks of the sun, moon, and planets, which we see.

The nearer a globe is to the eye, the smaller segment of it is visible, the farther off the greater, and at a due distance the half; and, on the same principle, the nearer the globe is to the eye, the greater is its apparent diameter, that is, under the greater angle it will appear, the farther off the globe is placed, the less is its apparent diameter. This is a proposition of importance, for, on this principle, we know that the same globe, when it appears larger, is nearer to our eye, and, when smaller, is farther off from it. Therefore, as we know the globes of the sun and moon continue always of the same bigness, yet appear sometimes larger, and sometimes smaller, to us, it is evident, that they are sometimes nearer, and sometimes farther off from the place whence we view them. Two globes, of different magnitude, may be made to appear exactly of the same diameter, if they be placed at different distances, and those distances be exactly proportioned to their diameters. To this it is owing that we see the sun and moon nearly of the same diameter, they are, indeed, vastly different in bulk, but, as the moon is placed greatly nearer to our eyes, the apparent magnitude of that little globe is nearly the same with that of the greater.

In this instance of the sun and moon (for there cannot be a more striking one) we see the misrepresentation of vision in two or three several ways. The apparent diameters of these globes are so nearly equal, that, in their several changes of place, they do, at times, appear to us absolutely equal, or mutually greater than one another. This is often to be seen, but it is at no time so obvious, and so perfectly evinced, as in eclipses of the sun, which are total. In these we see the apparent magnitudes of the two globes vary so much according to their distances, that sometimes the moon is large enough exactly to cover the disk of the sun, sometimes it is larger, and a part of it every where extends beyond the edge of the sun; and, on the contrary, sometimes it is smaller, and, though the eclipse be absolutely central, yet it is annular, or a part of the sun's disk is seen in the middle of the eclipsed, enlightened, and surrounding the opake body of the moon in form of a lucid ring.

When an object, which is seen above, without other objects of comparison, is of a known magnitude, we judge of its distance by its apparent magnitude; and custom teaches us to do this with a tolerable accuracy. This is a practical use of the misrepresentation of vision, in the same manner, knowing that we see things, which are near us, distinctly, and those, which are distant, confusedly, we judge of the distance of an object by the clearness, or confusion, in which we see it. We also judge yet more easily and truly of the distance of an object by comparing it to another seen at the same time, the distance of which is better known, and yet more by comparing it with several others, the distances of which are more or less known, or more or less easily judged of. These are the circumstances which assist us, even by the misrepresentation of vision, to judge of distance; but, without one or more of these, the eye does not, in reality, enable us to judge concerning the distance of objects.

This misrepresentation, although it serves us on some occasions, yet is very limited in its effects. Thus, though it helps us greatly in distinguishing the distance of objects that are about us, both with respect to ourselves and them, and with respect to themselves with one another, yet it can do nothing with the very remote. We see that immense concave circle, in which we suppose the fixed stars to be placed, at all this vast remove from us, and no change of place that we could make to get nearer to it, would be of any consequence for determining the distance of the stars from one another. If we look at three or four churches from a distance of as many miles, we see them stand in a certain position with regard to one another. If we advance a great deal nearer to them, we see that position differ, but, if we move forward only eight or ten feet, the difference is not seen.

VITA PER ASPECTUM. A very odd name given to the planet Mercury, but it is by a very odd set of people that it is given, the writers on judicial astrology. These authors hold certain of the planets to be fortunate, and certain others unfortunate in their own nature. Of the first kind is Jupiter, the most benign of all; of the latter are Saturn and Mars; the first of these they call Infortuna Major, and the latter Infortuna Minor. Mercury, they, on the other hand, held to be in himself neither good nor bad, but to portend good or ill, or to influence to good or bad actions, just according to the nature of the star with which it was joined in the aspect. It is in this sense that they call Fortuna Per Aspectum, fortune according to a dependant on the aspect; in which sense it is found, and in this sense we are to understand the old authors also, who say, that Mercury is like the star that it sees, Stella Mercurii fit similis illæ quam videt.

UM AL SAMA. A name by which some, who are fond of uncommon words, call the Milky Way; the name is Arabic, and expresses the exact sense of the words, the mother of the heavens. The Arabic is a very copious language, it abounds, on all occasions, with synonymous terms, but in none more than in those with respect to the phænomena of the heavens.

This is one of the less usual names of this part of the skies; the more customary are two, one of them Tarikal Lubanna, the other Tarik Al Tibin; the first names the space according to the Greek, the latter according to the Egyptian origin of it. The first signifies a way of milk, the latter a way of straw; for, as the Greeks said, this appearance was owing to milk spilt from Juno's nipple, the Egyptians said it was made by straw thrown burning behind their goddess Isis in her flight from Typhon. It is thus the Arabs have, in many cases, under different names, preserved the Grecian and the eastern fables. But this third name, Ulm Al Sama, is of a kind quite different from both, and is deduced from, not any account of the origin of the appearance, but commemorates an idle opinion as to its effects and virtues. Some of the old orientals supposed it the birth-place of the stars, and that fresh ones were, at times, sent forth from it into the other parts of the heavens. And the Latins believed it the great parent, or foster-mother, of all encrease below. Pliny produces an old opinion, that all the plants of this earth deduced their milky juices from it, and, from one or other of these imaginary qualities, it was called by this name.

UNICORN, *Monoceros*. One of the new constellations of the northern hemisphere, or one of those which Hevelius added to the old forty-eight asterisms, from the unformed stars.

It

It contains, according to Hevelius's account, only nineteen ſtars, but, according to that of Flamſtead, thirty-one, and its place is between the Great and Little Dog. *See* MONOCEROS.

URANISCUS. A name by which ſome of the old aſtronomers have called the conſtellation, which is more univerſally known under the name of the Southern Crown, or Corona Auſtralis.

URANOSCOPUS, *the Star-Gazer*. A conſtellation offered to the aſtronomical world in theſe obſervations, and compoſed of certain conſpicuous and unformed ſtars between the conſtellation Lynx and the ſign Gemini. The figure, place, and ſituation of the ſtars of which it is compoſed, have been exhibited in the ſame plate with the conſtellation Gemini.

The Uranoſcope is a ſea-fiſh of peculiar figure, and has its name from its eyes being in ſuch a poſition that it always looks upwards. Nature has deſtined it for living at the bottom of the ſeas, and its prey being always above it, this is the only direction of the eyes that could be uſeful. Moſt of the writers in natural hiſtory have named it, and it will be found figured and deſcribed at large in the hiſtory of animals, publiſhed, ſome time ſince, by the author of theſe obſervations.

The conſtellation is of conſiderable extent, and, in proportion to the ſpace it occupies in the heavens, is not ill furniſhed with ſtars. Theſe are happily enough diſpoſed to repreſent the figure, and the conſtellation is in this the more marked, that it takes in all the viſible ſtars in that part of the ſpace which it occupies; and without any forcing of the out-line, does not leave one out any where. The figure is that of a fiſh with a large head, the eyes looking upward, a body very thick toward the head, but thinner all the way to the tail, and that fin a broad one. It is very well marked in its place in the heavens, for it is over the head of Gemini, and under the belly of the Lynx, the reſt of the conſtellations about it are Auriga and Cancer, there is a ſmall ſpace left between theſe four conſtellations, in the middle part of which, and not very near to any of them, are the arrangement of ſtars, now thrown into a conſtellation, under the form of the Uranoſcope; that ſign is thence detached from all of them, and, as it were, ſituated at equal diſtance among them.

The belly of the Lynx runs almoſt parallel with the body of this fiſh, its head is under the fore legs of the Lynx, and at a ſmall diſtance from the right ſhoulder of Auriga; its tail is juſt over the head of Gemini, and its body over the extended arm of one of them, that which holds the dart. Cancer is at ſome little diſtance behind its tail, and below it.

The conſpicuous ſtars in the conſtellation Uranoſcope are ſeventeen, and of theſe there are ſeveral very conſiderable; there is one at the extremity of the head, and a little behind it another ſmaller, at ſome little diſtance behind theſe ſtand two in the place of the eyes, both conſpicuous and bright, a little beyond theſe are two placed on the lower out-line, and at ſome diſtance beyond theſe is a cluſter of four, placed alſo near the lower out-line, at the head of the body; after this there are three, two of theſe are near the upper out-line, and one is in the middle; beyond theſe is a ſingle one near the middle, then two others alſo near the middle, and the laſt, or ſeventeenth, is in the centre of the fork of the tail; this is ſmaller than the reſt, but it is ſufficiently conſpicuous.

URN. A denomination given by the

Greek aſtronomers to four ſtars, which are at the extremity of the right hand of Aquarius. *See them in the figure, and account of that conſtellation.*

URNA. A name by which ſome, who are fond of uncommon words, have called the conſtellation Crater; it is not a new fancy to call it thus. We read the word in ſome old poets.

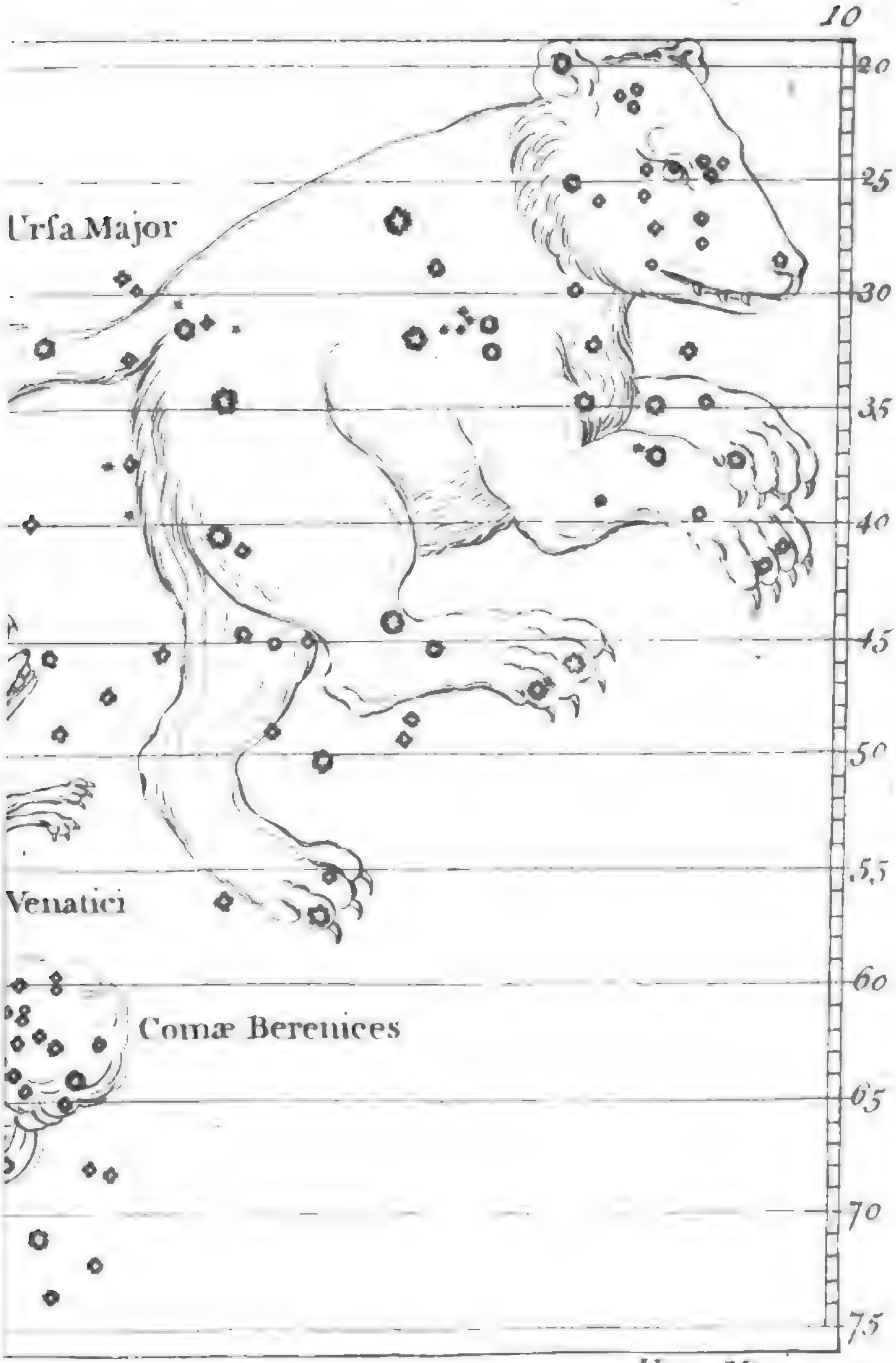
UROTALT. A name by which ſome, who love affected terms, call the ſun; it is one of the old Arabic names, and, in its proper ſignification, expreſſes the Lord of Light.

URSA MAJOR, *the Great Bear.* A conſtellation in the northern hemiſphere, one of the forty-eight old ones, and perhaps more antient than many of the others; for we find it alluded to and named, as familiarly known by the old writers. It ſeems by the name of Arcturus, mentioned alſo familiarly by Heſiod, that the Septemtriones were called in his time by the name of the Great Bear, but he does not expreſsly ſay ſo; and Homer, who probably lived ſometime after Heſiod, mentions it as obſerved by navigators, although Heſiod is ſilent as to that particular. It is a large conſtellation, and contains many ſtars; its ſituation is at a ſmall diſtance from the north pole, the Lynx is before it, the tail of the Dragon runs almoſt parallel with its back, and at a ſmall diſtance above it; the Hounds, or Canes Venatici, are juſt behind it, and the Little Lion is under its hinder feet: there are ſeveral large ſtars in its tail, on its buttocks, above the paws, and in the face. The old aſtronomers were not much better naturliaſts than the modern heralds. They have given the Bear a tail almoſt equal to its body in length; but if this does not belong to that creature, it very happily contains the ſtars we want to obſerve, and has uſe in the place of propriety.

The old aſtronomers counted thirty-five ſtars in the Great Bear, we find ſo many ſet down in Ptolemy's catalogue; Tycho allows but twenty-nine; Hevelius reckoned ſeventy-three, and about that number are marked down in the figures of the conſtellation; but our Flamſtead made them eighty-ſeven.

The conſtellations ſeem to have been deviſed by the Egyptians, and as they uſed all the figures of animals in an hieroglyphic ſenſe, might be ſelected to expreſs the ſituation of the ſtars contained in it, and, in ſome degree, their apparent motions. The animal they ſelected being an inhabitant of the north, and not famous for long journeys, or ſwift motion. The Greeks received it, doubtleſs, from the Egyptians, but though they retained the form, they loſt the meaning. It was their cuſtom to adapt part of their hiſtory, or fable, to the figures which were delivered to them from theſe people as comprehending the ſtars, and they might thus be ſuppoſed the inventors of them. They tell us, that this conſtellation owed its birth to the unfortunate Calliſto; this was a nymph of Arcadia, the daughter of Lycaon, king of the country, devoted to the chace, and thence led to aſſociate with the huntreſs Diana; they tell us, ſhe was a principal favourite with the goddeſs, but Jupiter debauched her; ſhe concealed the event as long as ſhe could, but it was diſcovered as ſhe was bathing. The virgin-goddeſs, they ſay, inſtantly transformed her into a bear, in which form ſhe brought forth her ſon Areas. After a ſeries of years, paſſed in the woods, they tell us, ſhe was taken by ſome huntſmen, and brought as a preſent to her father. She no ſooner ſaw her houſe than ſhe threw herſelf into a temple of

Jupiter,


10
20
25
30
35
40
45
50
55
60
65
70
75
Ursa Major
Venatici
Comæ Berenices
Ursa Major

Jupiter, whither her offspring followed her. The Arcadians, they add, were about to kill her for the profanation; but Jupiter, who had not been very grateful all this time, at length interposed, and took both the mother and the child up to heaven, making of Callisto the constellation, the Bear, Arctos, or Ursa Major, and of her son Arcturus. Others attribute the original transformation of the nymph into a bear to Juno, and say, that Diana, having loosed and killed her in that form, placed her among the stars; and some say, that Jupiter himself, for they do not seem to make him of any disposition, turned the poor princess into a bear himself to avoid the rage of Juno, and that she set Diana to kill her, and afterwards atoned for it by placing her among the stars. To account for this constellation's not setting, they tell us, that Tethis, the wife of Oceanus, having been Juno's nurse, would not receive the injurer of her bed into her bosom, though she willingly accepted all the other stars; so much pains did the Greeks take to adapt the Egyptian hieroglyphics to their own history.

The Greeks called this constellation Arctos and Helice; the Latins from the name of the nymph, as variously written, Callisto, Megisto, and Flemisto, and from the Arabians, sometimes Feretrum Majus, the Great Bier. They called also the Ursa Minor, Feretrum Minus, and the Italians have followed the same custom, and call them Cataletto. They spoke also of the Phœniceans being guided by the Lesser Bear, but the Greeks by the Greater. We find Ovid saying,

Helicen graia carina notat;

and much earlier among the Greeks themselves, Oratus, who wrote of the constellations, expresses himself to this sense:

Dat graiis Helice cursus majoribus astris
Phœnicas cynosura regit.

We have seen what is the Greek account of this constellation, but we have an opportunity of tracing it to a much earlier origin. It will at first seem strange to mention the Great Bear, as one of the constellations of the scriptures, but it is certainly so; and it is certain, even, that the Little Bear is named, or implied also.

All the constellations we find the names of in our English version are, Orion, the Pleiades, Arcturus, the Crooked Serpent, or Draco. The latter of these is undoubtedly the constellation here named, notwithstanding, that some have supposed the Hebrew term to mean the zodiac, and others the Via Lactea, or Milk Way; the other three words are translations of Chimah, Chesil, and Aish, of the original; but they are put strangely at random; and it appears abundantly, that those who have put them there, neither did, nor could understand the original. As to Arcturus, there is no proof of his being named in the bible, the Pleiades and Orion are, though these not as they are given in the translation, but the Bear also is, though not named in the translation at all. The translators of these books of the Old Testament seem to have taken the names of four of the Greek constellations, which are most familiar, and occur ofteneft, and to have put them for the four named in these places, as likely to be the same, not knowing them to be so; it was guess work, but it has happened, in some degree, to be right. They translate Chimah the Pleiades. "Canst thou bind the "sweet influence of Chimah?" is rendered, "Canst thou bind the sweet influence of the "Pleiades?" But Chimah means a giant, and is the name of the constellation Orion. For

Aish

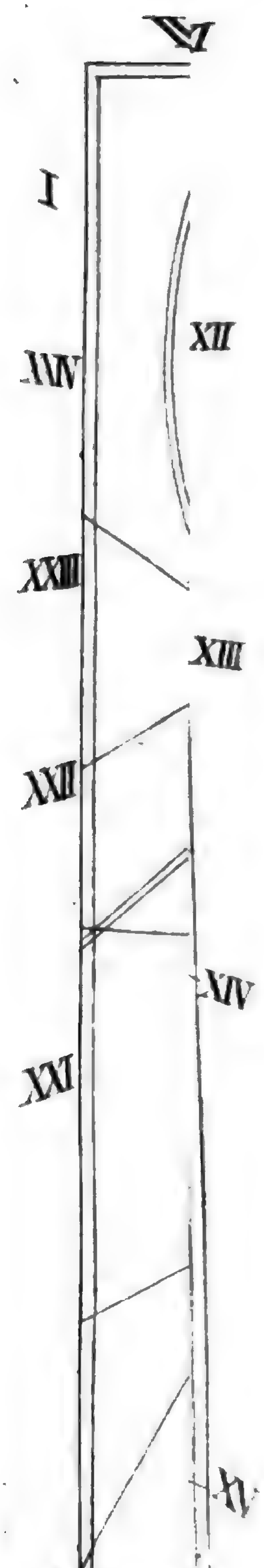
Aiſh they have put Arcturus, who maketh Aiſh and Cheſil, ſhould be, who maketh the Pleiades and the Bear; for Aiſh is the Pleiades, but they put it, who maketh Arcturus and Orion; and they have throughout confounded the whole matter.

Cheſil is frequently named in ſcripture, and the tranſlators have alway rendered it by Orion, but its ſignification is the Great Bear. That it cannot mean Orion is evident, becauſe Chimah means Orion, and both could not be names of that conſtellation, becauſe they ſtand together as two. But if we attend to the manner in which Cheſil is mentioned, we ſhall ſoon determine what conſtellation muſt be meant in the original by that word. Amos bids the people ſeek the great God of heaven and earth, the God who created Chimah and Cheſil. Cheſil therefore muſt be a conſtellation of conſequence to mankind; and as Orion was regarded by the huſbandmen, it is natural to ſuppoſe the other was the name of one regarded by ſailors. The Bear is ſuch a one. Iſaiah threatens the people when he is denouncing the vengeance of God againſt them, that the Cheſilim ſhall not ſhine. This ſhews, that there were two conſtellations of the name of Cheſil; for Cheſilim is the plural of Cheſil, and ſhews alſo, that they were of conſequence to mankind by their being threatned with their darkneſs. The two Bears are two conſtellations of the ſame name, and they are of this importance. Job ſays, "Canſt thou looſe the bands of "Cheſil?" Having tranſlated the influence of Chimah in the ſame paſſage by influence of the Pleiades, they render Cheſil by Orion; but what had Orion to do with bands, or with tying, or looſing? the conſtellation, which was truly meant by the word Cheſil, however had. The original name of the two Bears was not that of animals of any kind, but of two waggons. The antients repreſented them each under the form of a waggon drawn by a team of horſes, and the Greeks originally called them waggons and two bears; Amaxas is the old word for them. Now the Orion could have nothing to do with bands and tying, a waggon and a team of horſes very naturally had; the binding and looſing were terms extremely well applicable to an harneſs, and were very likely to be uſed in a figurative ſenſe in ſpeaking of that conſtellation.

Schiller, who has diſplaced all the conſtellations in favour of the Old or New Teſtament hiſtories, makes a boat out of the ſtars of this conſtellation, and calls it St. Peter's fiſhing-boat. Others, more moderate in the ſame ſpecies of enthuſiaſm, call this one of the bears of Eliſha, and the Leſſer Bear the other, or, when wheel-carriages, and not quadrupeds, are to be underſtood by theſe conſtellations, they make this the chariot of Elias, and the other, or leſſer wain, the chariot of Joſeph, though ſome have degraded it into the waggon of Jacob.

URSA MARINA, *the Sea-Bear*. A name by which ſome have called the conſtellation Cetus. We are not to wonder at the ſtrangeſt names, when they are given to creatures of the imagination, for this is abſolutely the caſe with reſpect to this figure. It is at leaſt as like a bear as it is a whale, and, if it reſembles any animal in nature at all, it is ſome of the large phocæ, or ſea-calfs, ſo that they, who called it Leo Marinus, or the Sea-Lion, ſeem to have anticipated the giving of that name to one of theſe ſpecies, which ſome late voyagers, who ſaw them on ſhore, gave to them at random.

URSA MINOR, *the Little Bear*. One of


I
XII
XXIII
XIII
XXII
XIV
XXI
XV

of the conſtellations of the northern hemiſphere, and near to the north pole, the great ſtar in the tip of its tail being very near to it, and called, from its ſituation, the pole-ſtar.

The Little Bear is one of the forty-eight old conſtellations, but, poſſibly, is of a ſomewhat later origin than the greater part of them. There remains no doubt of many of the others, indeed, almoſt all of them having been borrowed from the Egyptians by the Greeks, as this nation took the rudiments of all their aſtronomy from that early people, but it is much a queſtion whether the Egyptians had any knowledge of the Leſſer Bear: they, undoubtedly, invented the Greater, but this ſeems to have been invented by Thales, who lived about five hundred years before Chriſt, and did great things in the early aſtronomy. It is one of the ſmaller conſtellations, but, for its extent, it contains a conſiderable number of ſtars, and ſeveral of them large ones. The conſtellations neareſt to it are Cepheus and the Dragon, the tail of the latter conſtellation ſeparates it from the Greater Bear, which is at a conſiderable diſtance; the tail of the Little Bear runs between the feet of Cepheus, reaching almoſt from the one of them to the other, the body is between the right foot of that conſtellation and the tail of the Dragon, and its legs are in a direction almoſt parallel with that of the body of the Dragon, or at a ſmall diſtance from it.

There is very little in the diſpoſition of the ſtars in the heavens that could have determined the inventor to give them the form of a bear. Probably, Thales, if he was the inventor, meant no more than to put them into a form ſomewhat like that of the Great Bear, and did not much care about the diſpoſition of them. It is a very odd figure for the purpoſe; its head and legs are without ſtars, at leaſt without any of conſequence, and, in order to take in the pole-ſtar, and two other very conſiderable ones, which are in a line with that, the creature has a tail given to it conſiderably longer than its whole body and head put together, and carried in a fine erect poſition. This, although quite out of nature, and making the Bear in the heavens a very different animal from the bears of the earth, is, however, of great uſe in getting thoſe ſtars into form.

The antients counted eight ſtars in the Little Bear, we find ſo many allowed to it in Ptolemy's catalogue; Tycho reduced them to ſeven, but Hevelius made them twelve, and Flamſtead twice the laſt number. Three of theſe, all of conſiderable ſize, are, as already obſerved, in the tail; the reſt are on the body, and principally toward the hinder and lower part, for the head has none, nor are there any upon the legs.

The Grecian fable aſcribes the origin of this conſtellation to Cynoſura, but there is ſome doubt who, or what, Cynoſura was; ſome affirm, that it was no more than the name of one of Calliſto's dogs, and that the huntreſs was, after her transformation into a bear, carried up into the heavens, and made the conſtellation Urſa Major; the faithful companion of her ſports was ſent up after her. But the generality give the conſtellation a much nobler origin; they ſay, that Cynoſura was one of the Idæan nymphs that nurſed the infant Jupiter; and ſome ſay, that Calliſto was another of them, and that, for their care, they were taken up together into the ſkies. However it be, there are no blots upon record with regard to the character of this Cynoſura, and ſhe ſeems to have obtained her exaltation ſolely by her virtues.

We find the Leſſer Bear mentioned by all the old poets, and not unfrequently under the name of Phœnice as well as Cynoſura. The

occaſion

occasion of this appellation is evident; as to the other, Herodotus tells us, that Thales, who has been already mentioned as the inventor of the constellation, was a Phœnician; he was content to call it Arctos Minor, but his countrymen, to commemorate his honour, called it the Phœnician star; they also guided themselves by this in sailing, whereas the Greeks (as already observed under the head of Ursa Major) were directed by that constellation. The Phœnicians had more reason for this than that the constellation was first taken notice of by their countryman Thales. We find Aratus observing to this purpose;

Certior est Cynosura tamen sullantibus æquor,
Quippe verbis totam fido se cardine vertit
Sydoniamque ratem nunquam spectata fefellit.

A set of enthusiastic writers, Schiller, Schickard, and their followers, who will refer every one of the constellations to some part of the scripture story, make this to be one of the bears of Elisha, and the great one the other which destroyed the children. But for this we can pardon them, when the figure is understood to be that not of a quadruped, but of a wheel-carriage; they, in the same manner, make it to be the chariot of Joseph, or the waggon of Jacob; and all this is pardonable. But Schiller has carried the enthusiasm too far, he has altered the very figures of the constellations. Out of the stars of the Great Bear he has formed the figure of a vessel, which he calls St. Peter's fishing-boat; and, out of those of this lesser Bear, he has made that of an angel, and given it the name of St. Michael. This is making endless confusion.

VULPECULA ET ANSER, *the Fox and Goose.* A name of one of the new constellations of the northern hemisphere; it is one of those which Hevelius designed out of the unformed stars, and added to the forty-eight original constellations of the antients.

This is a figure of some consideration in the heavens, it is considerably larger than the Dolphin, to which it is near, and it contains a proportionably larger number of stars; the space which it occupies in the heavens is, indeed, very thick set with them, and some of them are of considerable size, so that it is an advantage, on many occasions, to be able to name them with this degree of precision. In general, the new constellations are so useful, that it is to be lamented there are not more of them, as there are stars enough to form them, and we are often at a loss to speak with the due regularity of them for want of such an arrangement.

The figures of the new constellations are, in general, much better drawn than those of the old, that is, they are nearer to nature. The choice of these two animals, under the forms of which Hevelius has arranged the stars of this constellation, is not greatly to be approved, there is a conceit in it unworthy of the subject, but we are to take them as they are given to us, and they are very tolerably drawn. The Fox is represented as having just seized upon his prey, and running away with it; the posture, in which he is drawn, is that of at once creeping and making off; and the Goose is represented as struggling as he holds her in his mouth, her wings are extended, and her head is bent to one side.

The constellations, between and among which the Fox and Goose is placed, are the Horse, the Dolphin, the Eagle, the Arrow, Hercules, Lyra, the Swan, and the Lizard. The fore feet of Pegasus come very near to the tail of the Fox, the head of the Dolphin is at a smaller distance under his hinder legs, the Eagle is at about an equal distance under his

his fore legs and under the Goofe, and the little conftellation of the Arrow is juft clofe under one of the legs; Hercules is at a confiderable diftance before the Fox; the head of the Swan comes very near to that of the Goofe, and the top of the two arms of Lyra are not at a great diftance.

Hevelius, who formed the conftellation, counted in it only twenty-feven ftars; but the difcerning Flamftead makes them thirty-five; they are none of them of the firft magnitude, but feveral are very bright and confpicuous, and, in general, they are tolerably well difpofed to mark the out-lines of the figure. There is one very bright and confpicuous in the knee of the left fore foot of the Fox, another at the tip of his nofe, a third in the wing, and a fourth in the tail of the Goofe, and there is one, equal to any of thefe, in the right fore foot of the Fox, but, this foot treading upon the Arrow, that ftar is common to both, and has been already mentioned in the account of that conftellation. The reft of the ftars in this conftellation are happily difpofed, there is one for the eye of the Goofe, and one at the top of the fame wing, at the tip of which alfo is the larger, and near to that large one there alfo ftands another fmall one; there is one on the middle of the Fox's nofe, another juft under his ear, one in his neck on the fore part, and another on his breaft; there are two over the fhoulder, and three at the belly, two at the infertion of the right hinder leg, one on the thigh of that leg, and one on the left, and one on each of the feet of thofe legs; there are two toward the origin of the long tail, and one at its extremity. The fpace, which this conftellation occupies in the heavens, is, on many parts, very well defined by the adjoining ones, and the ftars denote it extremely plainly, and obvioufly.

VULPIS, *the Fox.* A conftellation, or part of a conftellation, in the northern hemifphere, the whole figure confifting of an animal of this denomination with a goofe in its mouth, and being known by the name of the Fox and Goofe. It is one of the new conftellations added by Hevelius to the forty-eight original ones, and comprifes feveral of the unformed ftars of the old diftribution; it is placed over the head of the Eagle and Dolphin. *See* VULPECULA.

VULTUR, *the Vulture.* A name of one of the northern conftellations, more ufually known by the name of the Eagle, Aquila. The antients pretended, that this was the bird which preyed on the liver of Prometheus, and that the Arrow, which is a little above it in the heavens, was placed there in remembrance of that with which Hercules fhot this deftroyer. As they called this bird fometimes by the name of an Eagle, and fometimes of a Vulture, in the ftory of Prometheus; fo they gave one or other of thofe names to the conftellation in the heavens. *See* AQUILA.

VULTUR CADENS. A name by which fome, who are fond of uncommon terms, have called the conftellation Lyra. To explain the occafion of a name fo very different from the cuftomary one, this is to be obferved, that the conftellation was originally drawn in form of a vulture holding an antient lyre inverted. They alfo called it Teftudo, and Fidicula.

UTZERATH HAJAH. A term by which fome, who are fond of hard names, call Serpentary; it is the Hebrew name of that conftellation, and fignifies a man holding a ferpent.

W.

WAGGONER. A name by which some of the astronomical writers have called the constellation Auriga, others also have given the name to Bootes. *See the articles* AURIGA *and* BOOTES.

WAIN, *Amaxa*. A name by which we find the constellation, called Ursa Major by late writers, mentioned by the oldest of the Greek astronomers.

It is evident, that the astronomy of the present time, in whatsoever nation of the world it flourishes (unless we are to except the Chinese, though this is not certain) is derived from the Greeks; and it is as certain, that the Greeks received the rudiments of it from the Egyptians. We look up to Ptolemy as the father of astronomy. He mentions his predecessor Hipparchus with the same degree of reverence; and Hipparchus, whom Pliny supposed to have undertaken what was a work not for a man, but for a god, when he set about his catalogue of the fixed stars, speaks of Thales with the same degree of reverence. Thales, who is thus mentioned, travelled to Egypt, and brought thence, among other rudiments of astronomical knowledge, the figures of some constellations.

The Bear, we know, was one of the earliest of these, it was even prior to the time of Thales; for although he is said by some to be first of all the Greeks who travelled into Egypt on this occasion, it is plainly otherwise, since he is said to be the inventor of the Lesser Bear, that is, the person who brought the knowledge of it into Greece; and by the form of that account it appears, that the Great Bear was familiar then before his time. Thus much of the history of the bringing the constellations into Greece, is necessary to explain the figure, and the early name of one of the oldest of them, perhaps the very oldest of them all.

Although the stars, which are so very conspicuous toward the north pole, and which are at this time called the *stars of the* Great Bear, were so early taken notice of, they were not so early called by this name, or arranged under the lineaments of this quadruped. The Greeks, though they received the constellations from Egypt, made great innovations in them, and, I am sorry to say, not with the most ingenuous view. We find this constellation called in the writings of some of the English astronomers the Wain, that is, the Waggon; and that which is called the other Bear, is also called by the same name. The terms Greater and Lesser Wain being as frequent, in many writers, as Greater and Lesser Bear; this is no English, nor modern innovation. Amaxa, the Grecian name for this constellation, or, in the plural, for these two constellations, signifies a waggon, coach, chariot, or any other wheel-carriage, and

far

far from being a new, it is, as I set out with the saying, the antient name of this constellation. The Egyptians understood those stars as corresponding with the figure of a low cart, or carriage, such as stone is drawn upon, having four wheels, and drawn by three horses, placed one before the other. We find it thus represented among the hieroglyphical figures, inscribed on the earliest monuments of that country, and in company with those which represent Virgo, the Lion, the Crab, and Capricorn. It is sometimes also placed on those monuments, and it seems then intended as an emblem of stability.

The Greeks, who received this useful constellation, doubtless, nay, evidently; very early from the Egyptians, appear at first to have retained the stars under the same figure; and by this word Amaxa to have called it by the same name, for Amaxa, signifying at large a wheel-carriage, was, of all words their language afforded, the most proper for expressing the name of a carriage of that kind, not perfectly the same with any in use with them, and was probably intended as a translation of the period by which the Egyptians called it.

The Greeks when they began to cultivate astronomy in earnest, when they applied the other sciences to the heavens, and laid the foundation for those improvements which were after made, and which carried it to that amazing height at which the science, at length, arrived among them, grudged the Egyptians the honour of having known any thing of it before, and were unwilling that what they had improved to this surprising height, or what they had but laid the steps of so improving, should not be supposed the produce in its original of genius's in their own country. With this intent they added to the story of the constellations part of their own history, or of their own fable, that they might seem the offspring of that country to which such history, or such fable, belonged, as will be seen at large under the whole series of the forty-eight old constellations. When they found a lion in the sphere, it was said to be the Nemæan savage of that species which Hercules destroyed; if a dragon it was made to be that which guarded the Hesperian fruit, and which the same great hero slew, and thus of all the rest. But when they found figures that would not support any of these pompous trifles, they took a farther liberty, and altered them; this was the case with the constellation which is the subject of the present enquiry. A waggon was a coarse and paltry instrument, they knew not what to do with it; they had not one fable among all their legends into which so clumsy a machine could be introduced; they altered it. We find in their earliest times the constellation was given under the figure of a waggon, for they called it Amaxa, but this was afterward thrown out of the sphere, and a bear put in its place. This they delivered down to posterity as the animal of that species into which Calistho was transformed, and so the origin was as pompous, and as foolish, as that of any of the rest.

That the Great Wain, or Greater Bear, was indeed a very early constellation, is not only very natural to suppose, but it is very abundantly proved. We are told by the old Greek historians, that those who travelled over the immense desarts of Arabia, for there were people, adventurous enough to attempt this in the earliest times, guided their course by the assistance of those stars which were about the pole. That sailors, as soon as they grew bold enough to venture the sight of shore, must also have recourse to these is evident; and we do find the Bear, that is to say, the stars forming the constellation at this

 time

time called, though not then ſo named the Great Bear, was the conſtellation they uſed as their guide on theſe occaſions. That theſe land-travels were prior to long voyages, none will doubt, and as they were, doubtleſs, purſued with a view to commerce, carriages were, doubtleſs, employed in them to tranſport the goods of one part of the country to another; in this view of the matter the figure of the conſtellation will appear the moſt natural that could be given to it. What could be ſo familiar as to form thoſe ſtars into the figure of a carriage, the uſe of which was as a guide to carriages? If we look into the occaſion of the Egyptian conſtellation, we ſhall find this origin conſonant to thoſe of all the reſt. They had a mind to denote, by certain ſtars, the ſun's place at that period of the year when the young of the ſeveral ſpecies of domeſtic cattle, the lamb, the calf, and the kid, began to be ſeen about the paſtures; and whatever the figures that they choſe for the arranging the ſtars of theſe ſucceſſive ſpaces, the Ram and Bull, the fathers of the flock, with reſpect to the two firſt, and for the other the Kids themſelves, and a pair of them, for that is the old figure of the conſtellation Gemini, to ſhew, that they came forth in pairs, not ſingly, as the lamb and calf uſually offered. In this manner alſo a woman, with an ear of corn in her hand, a female reaper, denoted the time of harveſt; and a lion, the moſt furious of all beaſts, the rage of the hotteſt ſun in the month of his full power. If we conſider theſe as the occaſions and deſigns of the Egyptian conſtellations, and if we allow, as we aſſuredly muſt, the Wain, the Amaxa, to be one of thoſe conſtellations, we ſhall ſee, that nothing could be ſo natural, or ſo probable, as their giving to thoſe ſtars, which were to direct the traveller in his way with ſuch carriages, the figure of one of the carriages themſelves, for it muſt be confeſſed, that none could be ſo natural, nor any thing ſo conſonant with what appears to be their conſtant cuſtom. It is highly probable, that the venturing out to ſea was long after the inſtitution of theſe long land-travels, and nothing was ſo familiar, as that thoſe who did it ſhould have recourſe to the ſame ſtars, for their direction, that had before ſerved, and were probably, at that time, known to ſerve the others. When they were accuſtomed to the ſea, they found greater preciſion neceſſary than was needful at land, and conſequently they added the Little Wain, or that other conſtellation.

That theſe conſtellations were thus early known, will appear from all the authors who have had the ſlighteſt opportunities of mentioning any of them; we ſhall find them all mentioning the Bear and the Wain ſingly in many places, and by that we are always to underſtand them as meaning the Great Bear, and we ſhall find ſome, but not all of them, *occaſionally, mentioning* them both, or uſing what is generally underſtood as the name only of one of them in the plural number; and it is by this word that they expreſs them both when it is not neceſſary for them to be particular in the diſtinction, but only to allude to that part of the heavens.

We find the Bear and the Bears, the Wain and the Wains, mentioned in this manner in three different books of the Old Teſtament; indeed we find neither the name of the Bear, nor the Wain, in the Engliſh; nor Urſa, nor Plauſtrum, in the Latin; nor even thoſe of Arctos, or Amaxa, in the Greek; but it is not in the tranſlation, no not even in the Greek one, that we are to look for the things that concern aſtronomy: recourſe muſt be to the original, and that only can direct

us;

us; for not the Hebrews of later time themſelves, nor any of the tranſlators, nor the wiſeſt of the commentators, have any idea of the ſcience, from the foundations of which alone the meaning of thoſe words, which occur there as names of conſtellations, could be aſcertained.

That the writers of thoſe ſacred pages knew very well what it was they wrote about is plain; they were under too ſecure a guidance to have error poſſible; and wherever they have appealed to the heavens as teſtimonies of the power and goodneſs of the Creator, they have invariably referred to thoſe parts of them which were moſt conſpicuous, and of moſt immediate uſe to the world. Their plan being to expreſs the majeſty and goodneſs of God, they muſt have done this, ſince they well knew how to cauſe, and where to do it; but that is not all the proof, there is abundant evidence, from the manner of their ſpeaking concerning the conſtellations, which they were they meant.

But, though this knowledge lay among the witers of the Old Teſtament, we have no teſtimony, nay, we have no reaſon to believe, that any part of it was preſerved among their early readers. The Jews, we know, were ignorant and obſtinate, theſe were the qualities that made up their character; knowledge in the ſciences they never had, nor ever attempted to obtain; in their moſt proſperous ſtate they deſpiſed it; in their captivity it is not to be ſuppoſed they were in ſpirits to preſerve it, or, that they would have dared to do ſo with reſpect to this particular ſcience of aſtronomy, ſince that and judicial aſtrology were always coupled together by the people whoſe captives they were, conſequently the ſtudying of the ſtars would have been conſtrued into enquiring of them when thoſe diviſions and troubles, which were among their maſters, ſhould deſtroy their monarchy. Before their captivity, therefore, they did not, and in it they dared not, to ſtudy aſtronomy; after, it was the only time that could be ſuppoſed likely, ſince we read of ſchools and ſeminaries after their reſtoration in Alexandria. But let us look into the hiſtory of theſe, and we ſhall find them, as ever, out of the way of all knowledge in the ſciences, for they there ſuffered no ſtudies to be followed but thoſe of the recovery of their language, which was, in a great meaſure, loſt, and of the law of Moſes written in it. After this we know they required none.

Thus much is neceſſary to obſerve with reſpect to the Jews, ſince not one of their commentators give any notice of the Bear, or Wain, being a conſtellation named in the ſcriptures; but this we ſhall find to be no argument that it is not, nor were, that the verſion of thoſe books, in which the conſtellations are mentioned, called that of the Septuagint, names not this. In the firſt place, we are not aſſured that the ſeventy, who were engaged by Ptolemy in tranſlating the Old Teſtament into Greek, did ſo tranſlate the whole of it; and, if they only did a part, it is very probable theſe books made no portion of it; poſſibly it was only the law they tranſlated, or, if they went farther, probably the origin of the people, and the ſtory of their wars, was all; but we cannot ſuppoſe that the allegorical and prophetic books would be taken in, if any were left out; ſo that, if we ſuppoſe there was any part of the Old Teſtament not tranſlated by the ſeventy, the book of Job, and the prophecies of Iſaiah and Amos, may be naturally ſuppoſed to be among that part. It is in theſe books, and in theſe alone, the conſtellations are mentioned, and therefore, if the tranſlation, ſo celebrated for its

its authenticity, did not extend to all the books, these have no claim to its countenance. But let us suppose the whole Greek version of the Old Testament to have this sanction of the Septuagint authority; still I have shewn, that no perfect dependance is to be placed on their version of words which were the terms of a science, with which science they were perfectly unacquainted. We find these translators, whosoever they were, rendering the word Chimah, which signifies a giant, and which was the old name of Orion, by the word Pleiades, and we find them rendering the name of the northern constellation Draco by the plain words a crooked serpent, not seeming to understand it to have been the name of a constellation at all, but to have looked upon the words Nahash Barik to have meant one of the snakes under our hedges.

As to the Jewish commentators, the best of them are as wide of the matter as the translators, and confess a perfect ignorance in their perfect confusion; their perplexity, and idle attempts to explain Chimah and Chesil by a hot star and a cold star, are sufficient proofs of this, and he will have conviction enough of their perfect ignorance in astronomy, who, when he finds them talking of the Seven Stars, sees them blundering between the Pleiades and the Septemtriones.

It is necessary to shew that there is this perplexity and ignorance among the commentators, and even in the translators of some parts of the bible, with respect to this particular science, in order to justify that recourse which must be had to the original, to understand what was meant in particular by those words which are so palpably the names of some or other of the constellations. We know the origin of astronomy to have been very early in the world, and we may easily determine, that the first progress it made was no more than that of remarking certain clusters of stars which pointed out, by their rise, peculiar seasons, or marked invariably certain points in the heavens; the first served as a direction to the husbandman

Quo sydere terram
Vertere;

when he should change his land, when sow his crop, and when bring out his lambs into the pasture; the other directed the voyager, or traveller, who, in the desert, or on the wide sea, had no other mark to look upon. As early therefore, probably, as husbandry began, and certainly as early as commerce was undertaken, constellations were formed. A few of these served the purpose, and consequently a few only were established. These were all that were known for many ages, and curiosity, long after, added the rest. There are but four or five of these named in the Old Testament. The translators of the *Old Testament* were not enough informed of the science to which they belonged to know exactly which they were; they found an equal number, four or five also known to the early Greeks, and they gave the names of these as chance directed for the others. For the Chimah, Chesil, and Aish of the heavens, they gave the Pleiades, Orion, and Arcturus of the Greeks, and, although it happened, as very naturally might be expected, that two of these were the names of two of the Hebrew constellations, yet it has so happened, that they have not applied them to those two, but to two others.

Though we have reason to allow a very early origin to some of the constellations, yet we are not to suppose any of them so early as the old books of the sacred text. It has been pretended by some, that the book of Job was written

written by Mofes, but there are a thoufand reafons againft fuch a fuppofition, and were there not one more, the naming of conftellations in it would be enough to prove that it was not. There can be no reafon to imagine that any conftellations at all were formed in the days of Mofes, or that any owed their origin to the Jews. Had there been any, the fpirit of Mofes, who is full of the greateft images throughout his writings, would not have failed to mention them, as there are many opportunities in the courfe of his writings, under which he might have done it; but, from his perfect fcience on this head, and from the character of the Jewifh people, in and before his time, we have all the reafon in the world to determine none more than known.

We very well know, when Ifaiah prophecied: he afcertains the time himfelf, for he tells us the names of the feveral kings in whofe reigns he prophecied, and among them is Uzziah. We very well know when Uzziah reigned, and therefore we know of a certainty when Ifaiah prophecied; it was between feven and eight hundred years before the birth of Chrift. As to Amos, it is plain that he was a cotemporary, or very nearly a cotemporary with Ifaiah, for he alfo, as himfelf tells us, prophecied in the reign of Uzziah, fo that the greateft diftance that can be placed between them is only that of a few years, fuppofing one to have prophecied in the beginning, and the other toward the latter end of his reign. That authors of this time fhould mention conftellations is as natural, as it would be unnatural to fuppofe that Mofes could; for we can trace the knowledge of conftellations (though perhaps not of many conftellations) up to this time, among other nations. We can, of a certainty, fhew, that the Babylonians were acquainted with fome conftellations between feven and eight hundred years before the Chriftian æra, though, perhaps, all their own boafts of antiquity will not be able to carry it much higher; and, if we fuppofe this to have been the very period, as moft probably it is, at which the ftars began to be formed into conftellations, and their ufe known to mankind, it is the more natural that the prophets fhould appeal to them as proofs of the greatnefs of God's power, and as the means of his vengeance.

We need not be in fear that the book of Job, in which conftellations are mentioned, fhall carry up the origin of thofe affemblages of ftars higher than it is carried by the period of thefe prophets. Peace to the violence of thofe who have contended for that allegorical work having been written by Mofes! It is certain that it was done fome centuries after the writings of thefe prophets. There is abundant proof, even in the nature, language, and intent of the book, that it was written during the captivity of the Jews, and we very well know when that captivity began, and confequently can be affured within what period it muft have been written. It is evidently a work of confolation to the Jews in that diftrefs, and is as noble as judicious, and as inftructive an one as could have been conceived for that purpofe, not as the genius of man could have contrived, for it is much more than mortal. The unhappy people are foothed and flattered in it; they are taught the only means by which they can extricate themfelves, or by which they can obtain the divine favour; and they are fhewn, that, by fuch means, they will obtain it. The misfortune is not laid upon any crime of theirs, but, according to the freedom of the eaftern way of writing, upon the practices of an evil fpirit. What could footh an afflicted people fo much as being told, not their own crimes had brought

brought their afflictions on them, but things out of their own power? What could at once animate their hope and their resolution so nobly as the pointing out to them a man superior to all these misfortunes by his confidence in the power and greatness of his God? What could be so great a lesson of humility and resignation as the character and conduct of that sufferer? or what so glorious a prospect as that they have seen in the conclusion of the story of his wealth and his prosperity doubled by the blessing of that God whom he had never offended by repining at his miserable condition?

These are foundations on which the true period of the book of Job may be established; as to the times of those of Amos and Isaiah, they are as fixed as any point in history, and as inconteſtible. We thus see the three writers of the Old Testament therefore who have named the constellations, for no others have mentioned any, living at a time when astronomy was in its infancy, when only a few constellations were formed, and when only those few there could be named, these must have been the most of use, and it is easy to know therefore, that they must have been those which pointed out the times of agriculture, or were the marks of direction for navigators. We are therefore to expect a few of the old constellations to be named in these books, and must we not expect the Bear to be admitted among them? Can we imagine it possible, that a constellation which we know to have been of so early origin, and which we know to be so useful, could be omitted where any constellations were mentioned, especially when they were mentioned with intent to speak the glory and the goodness of God? Certainly, no. We are not to doubt but that Bear was one of the early, and one of the useful constellations. We find no author among the most antient who mentions any constellation at all, and who does not mention the Bear, or Wain, the Arctos, or Amaxa; and why should we suppose, or, in more proper terms, why did the translators of the books of Isaiah, Amos, and Job, suppose that three so early writers, should all name several constellations in their books, and yet omit to mention it? It is not necessary that we suppose sailing in use in their days to make it high in use. Diodrus Siculus tells us, that the earliest people had recourse to it in travelling over the desarts, where there were notices, or buildings, or mountains, to direct them.

But, though we could only infer from this, that it was improbable the authors of these books should have omitted the name of this constellation, or speaking of the Greater and the Lesser Bear, we shall be able to prove by the text, that they have named them, and that the terms, in which they have spoken of them, are such, that they could have been applied to no other constellation. We shall find a constellation called Chesil in the book of Job, and we shall find two constellations mentioned together by the same name in the prophecy of Isaiah; and the same name occurs again, in the singlar, in Amos; and from the context, from the manner of their mentioning the words, and from the metaphors, which, according to the manner of the east, they apply to them in naming them, we shall find, that, by the word Chesil, in the singular number, no other thing can possibly be meant except the constellation of the Great Bear, or Wain; and that by the same word, when made plural in Isaiah, no other thing can be intended but the two constellations the Greater and Lesser Bear, as they are now called, or, as they were called much earlier, the Greater and Lesser Wain. In Job, the word Chesil is mentioned twice, and both

both times in the ſingular number; in the ninth chapter God is deſcribed as he who created Aiſh, Cheſil, and Chimah, that is, as it is rendered, Arcturus, Orion, and the Pleiades; but the true tranſlation is the Pleiades, the Bear, and Orion. In this paſſage we ſee the word Cheſil put as the name of one of thoſe conſtellations which were of great uſe to mankind, and which gave a real inſtance of the greatneſs and goodneſs of God. Cheſil is therefore the name of a conſtellation of importance to mankind; the tranſlators have rendered it Orion, and this would have been a conſtellation of ſufficient uſe to authorize the conjecture, but Chimah follows it, and Chimah is the certain name of Orion, and conſequently Cheſil cannot be ſo, but muſt ſignify ſome other conſtellation. This is certain; but it has not been conjectured by any of the tranſlators, or commentators, that it meant the Bear. The ſecond place in which the word Cheſil is mentioned in the book of Job, is in the thirty-eighth chapter, the words are theſe; "Canſt thou bind the ſweet influence of "Chimah, or looſe the bands of Cheſil?" This we find tranſlated "Canſt thou bind the "ſweet influence of the Pleiades, or looſe the "bands of Orion?" Chimah being again tranſlated the Pleiades, though it truly ſignifies Orion; and Cheſil, Orion, though it means the Bear. The force of this paſſage ſhall be preſently conſidered in proof of this aſſertion; but, in the mean time, let us conſider the others.

The prophet Amos mentions this conſtellation in company with Chimah, juſt as they are mentioned in the book of Job, and with the ſame intent; he expreſſes by them the goodneſs and the power of God, and, as Amos is the earlier writer by a century or two, and was, doubtleſs, in great eſtimation among the Jews during the time of their captivity, it is extremely probable, that the author of the book of Job tranſcribed the paſſage from him. Amos is preaching repentance to the Jews, and he bids them turn to God; the God who hath done all good and all great things for them; and, to expreſs this, he calls their eyes up to the heavens, and calls him the God that maketh Chimah and Cheſil, that is Orion and the Bear, or, in plainer words, the God who gave them the conſtellation which directed them in the affairs of huſbandry, and the conſtellation which was their guide upon the ſeas, or over the deſart; the former being the uſe of Chimah, that is, Orion; and the latter of Cheſil, that is, the Bear. This text agrees in all things with the firſt mention of the conſtellation in the book of Job, that is, in the ninth chapter, and both meant to characteriſe Cheſil as a conſtellation of great uſe to mankind. Thus much we find, therefore, eſtabliſhed by theſe two paſſages. Thus much might, indeed, agree to ſome other conſtellations as well as to the Bear, but the Bear muſt be allowed one of thoſe conſtellations to which it might refer.

All that is proved by theſe paſſages, therefore, is, that Cheſil may mean the Bears, but there is that behind which will prove that it muſt, and that it can belong to no other conſtellation. We ſhall find Iſaiah mentioning it in his thirteenth chapter, and that in ſuch a manner as countenances, in the ſtrongeſt ſenſe, the opinion eſtabliſhed on the other texts, that Cheſil muſt mean a conſtellation of great uſe to mankind, and, at the ſame time, fixing it to the Bear. It is here that we find the word uſed in the plural number. The intent of the paſſage is a denunciation of the vengeance of God by the prophet for the ſins of the people; the words are, "The ſtars of "heaven and the Cheſilim ſhall no more be

" bright, or ſhine, and the ſun ſhall be dark at " his riſing, and the moon ſhall not give her " light." The tranſlators, not well knowing what to make of this plural of Cheſil, have rendered the word conſtellations in a general manner, without applying it to any; but the appropriated uſe of the ſame term, once in Amos, and twice in the book of Job, are, proofs ſufficient that it is not to be ſo rendered.

It is plain that Cheſilim does not mean the conſtellations in general, ſince then the word would have been unneceſſary in the text; the term ſtars, which had been before, ſignifying the ſame thing, for, that all the ſtars ſhall be darkened, and all the conſtellations ſhall be darkened, is juſt the ſame, and the bible, of all books in the world, moſt free from tautology; but, after ſaying in general, that the ſtars of heaven ſhould be darkened, it was very natural and forcible to urge the ſyſtem, by ſingling out ſome of the particular conſtellations which were moſt uſeful of all to mankind, and the advantage of which they would loſe by this judgment. It was moſt natural for the prophet, in this ſenſe, to name the two moſt important, and, if any one, at this time, ſhould aſk which are the two moſt important conſtellations in the heavens, certainly the anſwer would be, the two Bears, or Wains.

But this is not all; we ſee it natural that he ſhould name theſe, and we ſee it proved that he has named them; for he has named two conſtellations, which are expreſſed by a plural of the ſame ſingular, that is, (for it can admit of no other conſtruction) he has ſelected two conſtellations which were called by the ſame name, although diſtinguiſhed by the epithets that were added. The two Bears, or, as they were earlier called, the two Amaxas, or two Wains, are two conſtellations thus diſtinguiſhed by the epithets Smaller and Greater, and they were of importance enough to mankind in their uſe to juſtify all that was ſaid of them, and to make the obſcuring their light, or the cauſing them to ceaſe from ſhining, a judgment and a curſe of the ſevereſt kind upon the people. It will remain to aſk, Are there two other conſtellations in all the heavens of as great uſe as theſe to mankind? There are not. Are there two others, which are called by the ſame name, and might be expreſſed by the plural of the ſame word, and that are extremely uſeful? There are not. It is plain, that two conſtellations, thus uſeful, and two conſtellations thus called by the ſame name, are meant by the term Cheſilim in Iſaiah, and as there are no others which anſwer that deſcription, it follows, that the prophet meant, by Cheſilim, the Greater and the Leſſer Bear, or Greater and Leſſer Waggon, and conſequently that Cheſilim being Wains, Cheſil is Wain; and that where this word is uſed in the ſinglar number in the book of *Job*, *although* we find it tranſlated by the word Orion, we ought to underſtand it as meaning the Bear, that is, the Great, or Old Bear.

But there is yet one paſſage to be examined. I have already mentioned the words, they are, " Canſt thou bind the ſweet influ- " ence of Chimah, or looſe the bands of " Cheſil?" The tranſlation ſays, " Canſt " thou bind the ſweet influence of the Pleiades, " or looſe the bands of Orion?" The Pleiades were remarked, in very early time, for two things, and they were remarked for no more; theſe were, as the conſtellation which began the year, for they marked the new year by their riſing, and as the preſage of rain, but neither of theſe is the particular characteriſing the conſtellation Chimah in this place; ſo that there was from the context, or from the naming it, no reaſon in the world to ſuppoſe

pose the Pleiades were meant by it; beside, the same verse has mention of the word Aish, which is the old name of the Pleiades, and therefore, for the same reason that Chesil cannot be Orion, because Chimah, named in the same place, is that constellation, Chimah, were it not known that it signifies Orion, could not be put for the Pleiades, because Aish, which is the proper name of that constellation, stands in the same passage.

If we are to judge by the context indeed, and there is no better way of judging, Aish must, and can mean no other than the Pleiades, because Aish and its offspring, or, according to the eastern phrase, Aish and his sons, is a very proper expression applied to the constellation which opened the year, and which might therefore be called the parent, or the leader, of all the rest, and they might be called its attendants: and, in a secondary sense, owing to the custom of the Hebrew, its children. This makes it a beautiful expression, to speak of the Almighty as leading in the constellation Pleiades and its sons, though this could mean nothing if spoken of Arcturus, as the Greek translation has rendered it.

The settling one constellation ascertains another; and having thus, on the most firm foundation, determined what is the meaning of Aish and Chimah, the Pleiades and Orion, that of the third word will be much easier allowed. The Pleiades, Orion, and the Bear, were the three constellations most likely to be meant by these authors, because the three oldest, and the three most useful in the world; two of them we see do signify Orion and the Pleiades; were it therefore so, the probability would be great, that the third should signify the Bear. But this is only circumstantial reason; we have seen Isaiah speaking of Chesil as the common name of two constellations; we here see the author of the book of Job speaking of it under the form of an expression in which bands are mentioned. Let us examine what this means.

If we refer to the translation, we shall find the word Pleiades, in which there is nothing that could have the least reference to the word bands; but this, we know, is not the true meaning of the original name. If we look into the commentators, we shall find abundance of idle and unmeaning words about Chesil being a cold star, and binding up the earth, but this is too contemptible to be minded. Among the more rational, Bochart, who has considered these things largely, could never come at the truth in regard to the word Chesil, because the word before supposed Aish to signify the Bear, and by that shut himself out of the true sense of the word; and Costard, who has, with great judgment, adapted and appropriated all that was valuable in Bochart and Hyde, and a multitude more on the subject; although he falls upon the true meaning of the word, yet hits upon a very poor explication of the phrase that is in this place joined to it. He agrees that Chesil is the Bear, and, remembering that what is now called the Bear was once called the Waggon, he supposes that the unloosing the bands of Chesil alluded to the untying of the harness by which the horses were affixed to that carriage; but this is a low idea, and an unmeaning explication. It was much beneath the dignity of this writer, whosoever he was, when speaking of the power of the Creator in making a constellation, to talk of the harness of the horses; nor indeed would there have been any meaning in the passage; on the contrary, there is a sense of these words, loose the bands, which, being expressed of the Bear, or Waggon, (for in this sense it is all one by what name that constellation is called) have a

full and noble meaning, and at once illustrate and enforce the sense of the whole passage, while they characterise the constellation, and shew that no other could be named.

We agree that the Great Bear is the Chesil of this passage; its use to mankind was as a guide over seas and desarts, as that of Orion was presaging the time of the ripe pasturage and food for cattle. The constellation Chesil effected this great purpose, how? by being, at all times, fixed in one part of the heavens. We know the free and figurative method of the eastern writing; nothing could be more natural to that people, when speaking of a constellation, whose great character it was to be fixed in one part of the heavens, than to express themselves concerning it as tied, or bound there, and the removing it from its place, or taking away the character of fixedness, could be no way more naturally expressed than by this phrase of untying, or loosening the bands. Let us look into the passage in this view, and we shall see it, in all things, suited to the subject, and worthy of the writer.

The sentiment to be conveyed was, that the Almighty was the author of all good things to mankind, and the creator of every thing august and useful. There could be no objects in the visible creation so aptly applied to, on this occasion, as the constellations; arrangements of multitudes of stars, and beside their grandeur in appearance, serving mankind in the great purposes of life. The manner of expressing this torment was by asking of man himself, whether he could make such things, or whether he could prevent that good which the God who had created them, had destined them to be of to the world. The question was, in plain terms, this: Canst thou prevent the consequences of those stars appearing, whose rise promises, or presages summer? or, canst thou take from man that great direction which I have established for him in the heavens, to guide him in his travels and his voyages? How is this sentiment expressed! how? but in the most natural manner of all others, in which an eastern writer could have expressed it; it is done by particularising those constellations by their names, and alluding to their uses. Canst thou bind the sweet influence of the Orion? for that is the real constellation referred to in the passage. Canst thou prevent that when this constellation appears, the herbage of the field shall follow? Or, canst thou loose the bands of the Bear? that is, canst thou prevent that constellation from being fixed to the pole, in which situation it is the constant guide and director of mankind, and let it move like the other stars, or as the motion of the earth causes the other stars to appear to move? What could be so natural as to ennumerate, on this occasion, the great and useful constellations, or which could have been more properly mentioned, or how could any have been mentioned with more force and elegance? The passage is thus explained; and the Amaxa, or Wain, of the Greeks, is proved to be, as it has been at all times supposed, one of the oldest of the constellations.

WATER, *in the Moon*. Astronomers pretty universally call those obscure spots, which are seen on the moon's disk, by the name of water; but it is probably a name very little belonging to them. Water should reflect more light than land, and consequently those parts of the moon which were seas and lakes, ought to be brighter, not duskyer than the rest: many other things may be conceived better to answer this appearance, but there is an argument against it much greater than all this. There does not seem, by

by the most accurate enquiries, to be any such thing as water in the moon's composition. That planet seems formed of elements different from those of this earth. If there were water there must be exhalations, clouds, and an atmosphere about the moon, but we discover no such thing; nay, we have demonstrative proof that there is no atmosphere about that planet, since, if there were, the stars must alter their colour or figure, in going on, or going off her disk, as we should then see them through that atmosphere, but no such thing happens. The clouds also, which would be a necessary effect of water, if there were any there, would alter the appearance of the several spots as they passed over them, and they would look very different when we saw them through clouds, and when through a clear air; but no such change is perceived, they are the same at all times in colour and configuration, and it is evident therefore, that we do at all times see them through the same medium.

There is great probability therefore, that what we call water in the moon, is only some more loose or light, and rare part of her surface. It has been thought by some, that they are great extents of forest; be that as it may, that they are not water, nor that the elements, of which the moon is composed, have any thing like water, or capable of being raised in vapours by the sun, is certain: she is best calculated for reflecting light to us if she have not.

WATER-BEARER, *Aquarius*. A name of one of the constellations of the northern hemisphere, which is also one of the twelve signs. *See it described at large under the name* AQUARIUS.

WATER-SERPENT. One of the old forty-eight constellations mentioned by the astronomers of the earliest ages, and referred to by all who have written since their time; it is a constellation of a vast extent, greater than any other in the heavens, but it does not contain a proportioned number of stars; there are an hundred and eighty stars in Aquarius, and an hundred and thirteen in the fishes, and yet these constellations do not extend nearly over the space that Hydra occupies, though its stars are but little more than half the number.

The Hydra is one of those creatures in the heavens, the likeness of which is not upon the earth: but this is common to many. One would think the figure of a serpent as easy to draw as that of a river, but the head is misrepresented, as they have given long tails to their Bears, they have painted this Serpent with the head and beak, as it were, of a bird, and they have added teeth within it. There also runs a kind of undulated fin along the back.

The constellations about the Hydra are, Virgo, Leo, and Cancer, the Sextant, the Cup, the Raven, and the Centaur and Wolf; the three signs of the zodiac are almost parallel with it, but at some distance; the Crab is over its head, and is indeed very near, so that some of its feet almost touch the head, but the others are more distant; the Sextant is placed just over its back; there is a twist toward the head of that animal, and the upper part of the Sextant touches that, the under limb almost touches also a lower part of the back. The Cup and the Raven are also placed upon the back of the Hydra, but at a great distance below these, and the head of the Centaur, and one of the legs of the Wolf, come very near the tail underneath. The Ship and the Unicorn are under the part of the body that is nearer the head, but they are at a much greater distance.

The

The old aſtronomers allowed only twenty-ſeven ſtars to this vaſt conſtellation; Ptolemy ſets down ſo many, and we know he copied faithfully after Hipparchus, who made the original catalogue. Thus it ſtood among all the writers to the time of Tycho Brahe; that author counts only nineteen; Hevelius raiſes the number to thirty-one, and, laſt of all, Flamſtead makes it ſixty. Of theſe there is not one of the firſt, and there is only one of the ſecond magnitude; this is toward the upper part of the body. There are no more than three ſtars which have at any time been accounted of the third magnitude, and of theſe but one, which is generally allowed to be ſo, two of them having, by many, been degraded to the fourth. The allowed ſtar of the third magnitude is toward the tail, the laſt but one behind Corvus. Of the others, one is near the laſt bend of the tail, and the other at the head. It is not a wonder, that a conſtellation of this great extent, which has, in the whole, ſo few ſtars in proportion to that extent, and in which ſo very ſmall a portion, even of thoſe, are of the conſpicuous claſſes, ſhould be leſs marked in the heavens than any others; it is indeed one of the moſt obſcure among the conſtellations; the reſt of the ſtars which belong to it are principally of the ſmaller kinds, and they are very irregularly diſtributed over the figure, there are little cluſters of them in ſome places, and, in others, the body is for a great way naked.

The Greeks, who are eager to have aſtronomy ſuppoſed of their own origin, have thought it very proper to conceal the obligations which they had to the Egyptians on that head, and it is in this view, that to prevent the world from diſcovering, that they had borrowed the knowledge of their conſtellations from that country, they adapted part of their own hiſtory and fable to every one of them, by this means to fix the invention of them to that country where that hiſtory, and thoſe fables, were received. Thus, with reſpect to the Hydra, a conſtellation which they, doubtleſs, had, with the reſt, from Egypt, they have obſerved the Raven and the Cup, which are fixed upon its back, making two other leſſer conſtellations, and they have, from the whole, given this ſtory. Apollo, they ſay, at a ſacrifice, ſent the Raven with a cup for water. The Raven ſeeing a quantity of unripe figs on the trees, in the place where it went for water, ſtaid for the ripening of them, and then having eat as many as it could, carried Apollo his cup of water; in the mean time Apollo had uſed other water, and, they ſay, that, in return for the neglect, he ſtamped a laſting plague upon the Raven, that, during the time of figs ripening, it ſhould be unable to drink; and to continue the memory of ſuch an incident, they tell you, he took up the Raven and the Cup into the ſkies, and that he placed both the one and the other at a diſtance, on the back of a great Water Serpent, that the Raven might, in its thirſty ſituation, ſee the cup of water before it, and be unable to get at it for the motion of the Serpent. By this ſtrange and ridiculous ſtory, we may gueſs at the credit that is to be paid to the other hiſtories of the conſtellations as they are deſcribed by the Greeks. They knew nothing of the intent or meaning of the Egyptians who conſtituted the conſtellations, but invented any ſtory to give an account of them, rather than confeſs that ignorance. They have other fables about theſe three contiguous ſigns, the Raven, the Cup, and the Hydra, but they are as abſurd as this, and it were impertinent to give them a place here. *Some account of them will be ſeen under the heads* CRATER *and* CORVUS, *where the origin of thoſe conſtellations is ſpoken of.*

WEST.

WEST. That half of the circle of the horizon in which the ſtars appear to ſet, is called, in general, the weſt. The circle which divides the horizon into two halves is the meridian, and the two points, when the one of theſe circles interſects the other, are called north and ſouth; that which is neareſt the north pole is called the north point, that which is neareſt the ſouth pole is called the ſouth point. There is alſo an imaginary point in the midſt of the ſpace, between the one and the other of theſe either way, at equal diſtance from one of them, and from the other. That point of theſe two which is in the eaſtern half of the horizon, or in that half where the ſtars appears to riſe, is called the eaſt point, and that which is in the weſtern half, or that half in which the ſtars appear to ſet, is called the weſt point. *See* CIRCLES.

WESTERN HEMISPHERE. A term uſed by aſtronomers and geographers to expreſs a part, or an half of the earth, as divided by a meridian. Every meridian divides the earth into two halves, an eaſt and a weſt; as the equator does into two others, a north and a ſouth; but theſe are uncertain, according to the place of the meridian; whereas, the equator being a fixed line, the other diviſions are alſo certain. In order to underſtand this properly, we are to obſerve, that a meridian is a line, or great circle, drawn through the two poles of the earth, and through ſome particular place, whoſe meridian it is. From the diſpoſition of this circle, it muſt cut the ſurface of the earth into two hemiſpheres; and, as it cuts the horizon at right angles, marking the north and ſouth points upon the plane of it, the diviſion, which it makes of the earth's ſurface, muſt be an eaſtern and weſtern hemiſphere.

WHALE, *Cetus*. A conſtellation in the northern hemiſphere. *See the article* CETUS.

WHEAT-SHEAF. One of the Arabian conſtellations; they were forbidden to draw human figures, and conſequently enlarged the ears of corn in Virgo's hand into a ſheaf, and left out the reſt of the figure; it is a liberty they have taken with many other of the conſtellations.

WHEEL, *or* IXION'S WHEEL. A name by which ſome have called the conſtellation Corona Auſtralis, or the Southern Crown; it is not a new name, we find Ixionis Rota in many authors.

WINTER TROPIC. A name by which many have called that tropic which is more uſually named the tropic of Capricorn; the terms are both proper, one of them expreſſes the ſeaſon of the year at which the ſun arrives at this its extreme circle ſouth, and the other the conſtellation through which the extreme circle of the ſun's motion paſſes.

The winter tropic is that parallel which the ſun deſcribes by his diurnal motion on the eleventh day of December, on which he paſſes through the ſign Capricorn, and is the moſt ſouthern parallel, with reſpect to the equator, that he ever makes.

There are two days in the year in which the ſun is in the equator, theſe are the tenth or eleventh of March, and the eleventh or twelfth of December. To explain what is meant by the winter tropic, or the circle of return of the winter ſeaſon, we muſt trace the ſun's motion from this ſecond entrance into the equator, which happens at his return from the greateſt declination north, and is on the eleventh or twelfth of September.

The

The ſun's place in the heavens, we are to obſerve, is not the ſame any two days together, for, during the whole ſummer, he is declining north, or elſe returning from that northern declination; and, during the whole winter, he is declining ſouth, or elſe returning from that declination. On the twelfth of September then, the ſun's place is in the equator, and conſequently the ſun's diurnal motion, for that day, is in the equator, but the ſun never remains a day in the ſame place, and, during the winter, his declination is ſouth, conſequently, on the thirteenth day of September, the ſun's place is not in the equator, but is at a little diſtance ſouth of the equator, and his diurnal motion is therefore performed in a parallel at that diſtance from the equator, for this motion is always performed in a parallel which is drawn through this point.

On the fourteenth day of September the ſun's place is at a ſomewhat greater diſtance from the equator than on the thirteenth, and conſequently the parallel is yet more diſtant. In this manner the parallel of the ſun's diurnal motion changing with his place, is, every day, more and more diſtant ſouth of the equator, till it arrives at the moſt remote place ſouth, where, when it is come, the parallel, which it deſcribes in its diurnal motion, is the moſt remote that can be, and is therefore called the tropic, or circle of return.

This change is ſo little in the ſpace of a ſingle day, that it is not much perceived, but, in the ſpace of three months, every day of which has added to it, it is very conſiderable. On the eleventh day of December, the parallel, being the moſt diſtant ſouth the ſun ever makes, paſſes through the conſtellation Capricorn. It is called the tropic at this place; and from this every day brings the ſun again nearer and nearer to the equator, and conſequently makes his diurnal motion deſcribe ſmaller and ſmaller parallels; and, at the length, after as much time has been employed in bringing him back, as was in carrying him ſo far away, that it is on the eleventh of March he is again got back to the equator; and after, for one day, performing his motion in that circle, begins to decline north toward the ſummer tropic.

When we ſpeak of the ſun's motion in all this, it is in compliance with cuſtom; the ſun, we know, ſtands ſtill, it is the earth that moves.

X.

XIPHIAS, *the Sword-Fish.* One of the constellations of the southern hemisphere, at least it is the name of one; for as to the figure, that is indeed not of the Sword-Fish, but the Saw-Fish. This is not to be expected among the old forty-eight constellations, or its name among the antient astronomers; it is one of those that the writers of late days have added to the account. It is a constellation of very considerable size, but, in proportion to its extent, it comprises but a very few stars. Its figure, as represented on the globes, and in the schemes of the heavens, if it had been called the Saw-Fish, instead of Sword-Fish, would have been tolerably well done; this is a very singular circumstance, with regard to a new-formed constellation. The old writers were less acquainted with natural history than we are at this time, and they therefore might be excused for drawing things less accurately; beside, they had often allegorical meanings to express by the figures of the constellations, or used them as a kind of hieroglyphical language. They were therefore determined in their choice from the consideration of meaning, and it was natural enough for them, if an exact figure did not so well as it was to be wished, take in all the stars they wanted to comprise under its lines, to make some additions to, or alterations in it; but as neither of these is the case with the forms of the new constellations, they are certainly to blame in not being accurate. The Sword-Fish and the Saw-Fish have each a long weapon growing from the snout, but in the Sword-Fish it is slender and plain, or smooth at the edges; in the Saw-Fish it is broad, and notched, or dentated with teeth like a saw: it is odd, that so striking a characteristic should escape any one who drew the figures, and it is the less to be pardoned, as the one would have comprised all the stars intended to be contained under it, as well as the other. We may easily alter this in future delineations, and, I hope, for our credit, with our successors, it will be done.

There is no constellations very near to the Xiphias; those which are placed about it, at a distance, are, the Eridanus, the Hydrus, the Royal Oak, the Ship, and the Dove; a part of the Eridanus runs under its tail, the bent part of the Hydrus comes toward the side of its neck, the root of the Royal Oak is over its head, the stern of the Ship is on the opposite side to the Hydrus, and the Noah's dove is at a distance, but in a parallel direction with the hinder part of its body.

The stars which are set down as belonging to this great constellation are only six.

There is a small one near the origin of the Saw or Sword, as we are to call it, another about the middle of the head, and a third a little lower. The largest in the constellation is on the lower part of the body toward the tail, and there is another just at the root of the tail, and one at the extreme corner of it, on the side toward the Dove, though these are so few, yet their disposition favours their, being remarked, and, they say, the constellation is very easily known.

Y.

YA'C. A term under which some of the fanciful, among the astronomical writers, have mentioned the constellation Sagittary; it is the Turkish name of that sign, and, in that language, signifies an arrow, and, figuratively, an archer.

YARD, *or* Golden Yard. A name given by our sailors to the stars which compose the belt of Orion. These are so very conspicuous, that they have always been remarked in the heavens. The Arabs call them Mintaka Al Giauza. Our astrologers, who love hard words, preserve the term; it means only the belt of Orion.

YEAR. The original signification of the word, which has been rendered year with us, and, in the other languages, by some word signifying the course of the sun round the earth in its apparent motion, originally signifies only a revolution, and is not limited to that of the sun. We find, accordingly, by the oldest accounts, that people have, at different times, expressed by it other revolutions, particularly that of the moon; and, consequently, that the years of some accounts are to be rendered only months. This will help us greatly in understanding the accounts certain nations give of their own antiquity. We read expresly, in several of the old Greek writers, that the Egyptian year, at one period, was only a month, and we are told, that, at other periods, it was four months. There is no nation, for the understanding the history of which such a consideration is more necessary, for the Egyptians talked, almost two thousand years ago, of having accounts of events forty-eight thousand years distance. We must allow a great deal in their accounts to absolute fallacy. They had, in the time of the Greeks, the same ambition which the Chinese have at present, and wanted to pass themselves upon that people, as the others do upon us, for the oldest inhabitants of the earth. They also had recourse to the same means, and both the present and the early impostors pretended to observations of the heavenly bodies, and recounted eclipses, in particular, to vouch for the truth of their accounts. The Egyptians told the Greeks of very near four hundred eclipses of the sun, of which they had the registers; and the Chinese have attempted to palm things of the same kind upon us, but the missionaries among them (such of them at least as have not been credulous) have discovered a part of the fraud, and computation has made out a great deal of the fallacy.

That the Egyptians were, indeed, a very old people, and that they had, from their fathers, observations of the stars, is certain. We owe astronomy to the Greeks, and the Greeks owed its rudiments to them. It was

from among them that the division of the zodiac was brought into the rest of the world, and this very division proves them to be an old people; they preserved its characters on the most antient of their buildings, and it appears, from the nature of those characters and figures themselves, that they were not invented there. Virgo, with her ears of corn, was the sign into which the sun entered at the time of the harvest, and Aquarius, with his urn, denoted the rainy season of the winter; but neither of these could be devised in Egypt, for there the harvest is not in September, which is the time of the sun's being in Virgo, but in March or April, and there is no rain at all there. It is plain, therefore, that their fathers had established this division of the zodiac before they came into Egypt, probably in the plains of Shinar; so that they are, indeed, earlier in their claim to astronomy than themselves know of; but how long their practice of it in Egypt had been, there is no determining. Beside their account by years, they compute also by their reigns of kings; but kings in Egypt were not always kings of Egypt; that kingdom was, in early time, divided into a multitude of petty principalities, so that, if they take the names of all the lords of these, of whom fifty may have been alive at a time, and whose mutual quarrels, and frequent wars, may have made many of them very short-lived, they may, by placing them over one another as so many kings succeeding to each other, after a reign of twenty years a-piece, produce a period as long as that of their time produced by accounting months for years, and adding, at their pleasure, even unto those, by thousands at a time. Since the time in which the solar year, or period of the earth's revolution round the sun, has been received, we may account with certainty; but for those remote ages, in which we do not know of a certainty what is meant by the term year, it is impossible to form any conjecture of the duration of time in the accounts. The Babylonians pretend to an antiquity of the same romantic kind; they talk of forty-seven thousand years in which they had kept observations; but we may judge of these by the others, and of the observations as of the years. The Egyptians talk of the stars having four times altered their courses in that period which they claim for their history, and that the sun set twice in the east. They were not such perfect astronomers, but, after a round-about voyage, they might mistake the east for the west when they came in again; but this would not add much to the credit of their account, although it might exculpate them with regard to absolute fallacy.

YEAR, *Solar*. The solar year is the measure of that time which the sun, according to the system of Ptolemy and Tycho Brahe, or the earth according to Copernicus; and truth employs in its proper motion from west to east to run through the ecliptic, and return to that point of it from which it is set out. Astronomers, when they speak with the necessary precision concerning the solar year, distinguish between the apparent and the mean year.

The mean solar year consists of that time which measures the return of the sun to the same point of the ecliptic, considered from the centre of the mean movement; this is always the same, it is not subject to any variations.

The apparent solar year is the time which measures the return of the sun to the same point of the ecliptic, considered from the centre of the earth; this is not always of the same extent, but is liable to certain variations, which variations are caused by the movement

of the apogee and perigee of the ſun. [*See this explained under the article* APOGEE.] When we know the difference between the apparent ſolar year, and the mean ſolar year at all times, or for all the points of the zodiac, which will be familiar after theſe conſiderations, we ſhall deſire to determine the duration of the apparent ſolar year, in order to deduce the mean year; this is to be done by the riſing and ſetting of the ſun in the moſt familiar manner. No more is neceſſary than to mark ſome fixed point on the horizon, at which we have ſeen the ſun riſe, or ſeen it ſet on any particular day of the year; and to watch the time at which it returns to the ſame point, or riſes, or ſets again at the ſame place, after having paſſed the two points of the ſolſtice. We ſhould continue theſe obſervations for two or three days before, and one day after the day of the ſun's returning to the ſame point; or ſuppoſe it only one day before, and one day after, we are then to meaſure the arc of the horizon, intercepted between theſe different points, and after this ſay, as the arc of the horizon compriſed between the riſing, or the ſetting of the ſun, from one of theſe days to the other, is to the arc of the horizon, compriſed between the riſing or ſetting of the ſun from one year to another; ſo are twenty-four hours to a fourth number; which being added to the number of the days between the two firſt obſervations, will give the true greatneſs, or extent, of the ſolar year.

The magnitude of the ſolar year may alſo be determined by obſervations of the fixed ſtars, compared with obſervations of the ſun; or it may be done by the meridian altitudes of the ſun; but no method can be ſo familiar as that firſt mentioned, and it would be tedious and uſeful here to lay down the methods of doing according to any other, by which ever it is done, the purpoſe is anſwered in the ſame manner.

YENKUTEK, *or* YENKITEK. A name by which ſome have called the conſtellation Cancer; it is the Turkiſh name. They alſo call it Lenkanteb and Lenkitek.

YIDGHER YILDUZ. A name by which ſome have called the conſtellation Urſa Major, or the Great Bear; it is the Turkiſh name of that conſtellation, and expreſly ſignifies the Seven Stars. The Greeks called the Bear by the ſame name, and from this has ariſen all that ſtrange confuſion that we find between the Bear and the Pleiades.

YILANGE. A name by which ſome, who are fond of uncommon words, have called the conſtellation Sagittary; it is the Turkiſh name of that ſign, and from it is derived the Arab Al Hangal.

YILENKUTEK. A name by which ſome have called the conſtellation Cancer; it is one of its Turkiſh names. They call it alſo Lenkuteb and Lenkiteb.

YUNGH. A name by which Mars is called in the Chineſe aſtronomy. The proper ſenſe of the word is Flame. They call it alſo Ho-Fire; it is from the redneſs of his appearance.

Z.

ZABIISM. That kind of supperstition which led men to worship the stars. The first people who fell into this species of idolatry were called Zabii, from Zeber, an Hebrew word, signifying the stars. It seems not improbable, that these were the authors of the first division of the heavens into constellations, and from remarking them as presaging the seasons of rain and fair weather, they looked upon them as the causes of those things, supposing them actuated by some divine spirit, and of the nature of the deities. It was very natural to reverence that which they supposed thus possessed of power to do good or hurt, and there is reason to conclude this one of the earliest false religions in the world.

ZAHALA, *or* ZOHOLO. A name given by those, who are fond of uncommon terms, to the planet Saturn; it is not a coined term, but is one of the Arabic names of the planet, and though it does not much honour to those who force it into use in our language, when it is neither necessary, nor, in general, intelligible; it is a credit to those who gave it originally, it signifies something that goes backward, and was a term therefore very properly given to that planet, which is of all the most retrograde, or has the most appearance of going backward.

ZENITH. That point of the heavens which is immediately over our heads.

ZERNAIZAN, *Fistulator*. The Persians call by this name the constellation Hercules; they probably therefore make some variation in the figure. Some of our writers, who are fond of being obscure, called it by the same name.

ZODIAC. A circle in the heavens, supposed to be in form of a belt or girdle, of sixteen degrees in breadth, in the middle of this belt runs the ecliptic; this belt is divided into twelve equal parts, each containing thirty degrees; these are called the signs of the zodiac, and they heretofore did correspond to twelve constellations, the names of which are therefore continued to them to this time, these are Aries, Taurus, Gemini, &c. *See the article* CIRCLES *of the Sphere*.

ZONE. A name given by some writers to the circles of the sphere in general, but by most of them to the zodiac in particular; it has been the custom of almost all nations to call this circle, in particular, the belt, though the rest have equal claim to the appellation.

ZONES. A term of division of the earth's surface among the old astronomers and geographers,

graphers, which is neceſſary to be underſtood, in order to the comprehending their deſcriptions. The aſtronomers uſing the term to explain the different appearances of the ſun, and other heavenly bodies, and the length of days and nights, and the geographers, as they did the climates, to mark the ſituation of places; they kept in uſe both the diviſions of the earth, this into zones, and that into climates, and they uſed them according as they were inclined, or were able to ſpeak with greater exactneſs; if they knew particularly what they treated of, they generally ſignified it by the mentioning what climate it was in, and if they were leſs accurate about it, they expreſſed themſelves by a more vague term, and ſaid in which of the zones.

It will be apt to puzzle thoſe, who are unaccuſtomed to the terms, to find them talking of theſe zones under different numbers, ſome calling them five, and others ſix, but this will be eaſily explained, for thoſe who made them ſix, added nothing to the five, but only divided one of the five into two.

Five is the original number of the zones, and they had their names thus; one is called the torrid zone; the two adjoining to this, one on each ſide, the two temperate zones; and the two more remote, or adjoining ſeverally to the remote edges of theſe, were called the two frigid zones. This is the conſtant ſenſe of thoſe who make them five; and thoſe, who ſpeak of ſix, make two torrid zones, as well as two temperate and two frigid ones, by dividing the torrid zone exactly into two in the middle.

Having thus underſtood what the antients mean by the term zone, and by its diviſions, we may determine what they were, how extended, and whence framed. The zones were diviſions of the parts of the ſurface of the earth made by the tropics, and by the polar circles. They conſidered that part of the globe, which is between the two tropics, as conſtituting one zone, this is what they call the torrid zone; and when they ſpeak of two torrid zones, it is ſtill of this only that they ſpeak, for they conſider it then as divided into two parts by the equator, and call each of the halves a torrid zone, diſtinguiſhing them ſometimes by the addition of northern and ſouthern torrid zone; but it is much more cuſtomary with them to conſider the whole as one part of the globe, and call it by the ſingle name of the torrid zone. The part of the globe, that lies between each tropic, and each of the polar circles, they called a temperate zone; theſe, therefore, are two, they comprehend each a large extent of country, and are continued from one of the tropics to one of the polar circles. From each polar circle to each pole was another diviſion; theſe formed two other zones, which they called the frigid zones, each of theſe extended from one of the circles to the adjacent pole.

According to this diſtribution of the earth, the Almighty ſeemed to have formed a very conſiderable part of it to no ſort of purpoſe. The temperate zones were the whole of the earth's ſurface which they thought habitable; and the torrid zone they underſtood to be too hot, and the frigid zones too cold, for that purpoſe; but all this was error. We find, that, although the cold is very ſevere within the polar circles, yet there are, very far within them, people, who live, and are happy, and who have refuſed, on very great advantages, to change their climates. They are as fond of their long nights, and ice, and ſnow, as the Swiſs of their mountains, and, as thoſe ſeem made for their inhabitants, and their inhabitants for them, it is juſt ſo with reſpect to the ſnows and colds of the countries within the polar circles. As to the torrid zone, they

ſuppoſed

ſuppoſed its heat as terrible as the froſt of the frigid; but they erred equally in this, for we find that many parts of it are the countries of very happy people. When the ſun is moſt powerful there, they have cool breezes, and frequent ſhowers, which cool the air, and refreſh them continually.

ZURNAI ZAN. A name by which ſome, who are fond of hard words, have called the conſtellation Hercules; it is a Perſian name, and ſignifies a man playing upon a golden pipe, they muſt therefore have figured the conſtellation differently.

ZYGUS. A name by which ſome have called the ſign Libra; it is one of its Greek names.

F I N I S.